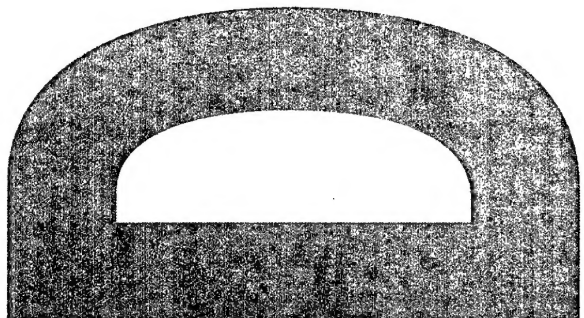
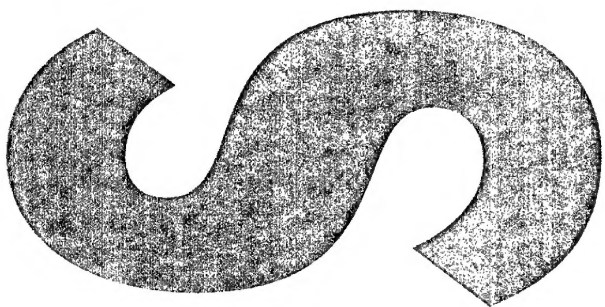
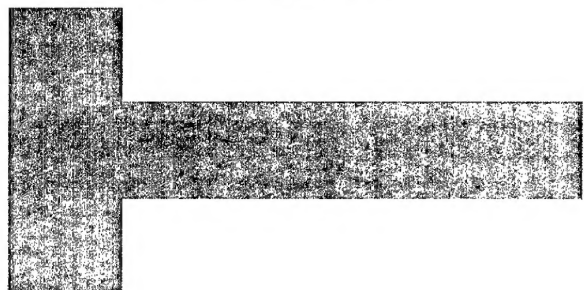
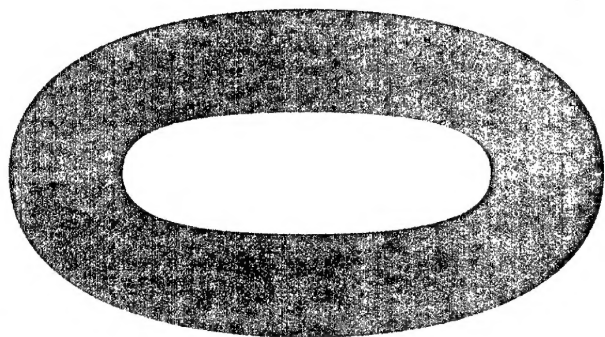




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The Network Centric Warrior: The Human Dimension of Network Centric Warfare

Leoni Warne, Irena Ali, Derek
Bopping, Dennis Hart and
Celina Pascoe

DSTO-CR-0373

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Leoni Warne, Irena Ali, Derek Bopping, Dennis Hart, and Celina Pascoe

Defence Systems Analysis Division
Defence Science and Technology Organisation

DSTO-CR-0373

ABSTRACT

Much of the NCW related work done by the military has been in technological and operational domains. The literature review in this report focuses on the human and organisational factors that need to be considered to make the most of the future NCW context and enable future warfighters to deal with war, peace, terrorism and overall uncertainty. Particular focus is placed on the transformation of warfighting and the issues that individuals and groups face in the NC environment. Such issues include: organisational culture, cognitive demands, the nature of information, C2 processes, knowledge mobilisation and learning, and transformational pathways organisations may follow while changing from a traditional hierarchical way of operating to more flexible and decentralised structures. The report concludes with suggestions for future research in the human dimension of effective NCW.

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The Network Centric Warrior: The Human Dimension of Network Centric Warfare (U)

Executive Summary (U)

This report is an output from the STR 03/242 Human Dimension of Future Warfighting Task. The primary research objective is to investigate the human issues that need to be considered and supported to make the most of the future Network Centric Warfare (NCW) environment and to understand the changes that should ideally take place to optimise this form of warfare. Within this context, one of the desired outcomes is to identify the new skills and characteristics that are required by future warfighters.

The scope of this document includes a review of literature with particular emphasis on the context of NCW for future warfighting, in terms of organisational paradigms and implications for warfighters. It also discusses the commonly accepted characteristics of traditional and future warfighting; gives an overview of current doctrine on NCW and the essential challenges this brings for the human dimension of NCW; discusses the future skills, competencies and workforce requirements for NCW; proposes possible organisational transformation paths; and suggests possible future directions for this research.

NCW is the military application of networked organisation concepts originally conceived in a business context. Specifically, it attempts to exploit the increasing interconnectedness between organisational units to allow better communication, information sharing, cooperation and therefore flexibility, adaptability and effectiveness. However, traditional organisational structures and arrangements are most probably inappropriate to take advantage of the new possibilities. For example, it is likely that flatter organisations are necessary, along with increased autonomy at lower organisational levels. Nevertheless, there remain other challenges originating from human capabilities to function in such an environment, such as the ability to deal with, interpret and act upon vastly increased information flows.

Traditionally, warriors were required to exhibit qualities such as discipline, fitness, decisiveness, leadership, obedience, patriotism, sacrifice and loyalty. But while these remain important qualities in many circumstances, others emerge as potentially necessary in the new NCW context. These include a broad range of expertise, cooperativeness, open-mindedness to innovate within the context of command intent and to accept responsibility for initiatives taken. These qualities are seen to be increasingly relevant given the emergence of non-traditional military roles such as Military Operations in Urban Terrain (MOUT), Military Operations other than War (MOOTW) and so on, but may in some ways be incompatible with the more traditional picture of the warrior. Recent conflicts give some clues as to how the military and military organisation may need to

transform itself in order to take advantage of the possibilities of NCW. For example, the conflicts in Iraq and Afghanistan were characterised by more flexible and responsive patterns in addition to far more integration of joint capabilities and force mixing. Nevertheless the potential lessons need to be viewed with caution given the lopsided NCW capabilities of the combatants in these cases. To achieve NCW capabilities will also require significant changes in how Australia's military is internally organised and managed. Issues concerning promotion, rotation, specialisation, recruitment and retention stand out as areas of concern although there are differing views regarding the impact of NCW on the skills and competencies required of ADF personnel.

NCW is based on the idea that information is only useful if it allows personnel and units to act more effectively. This makes understanding the people and groups in the network, and more particularly their capabilities and limitations, fundamental to successful NCW. NCW aims to communicate the commander's intent while encouraging lower level units to self-synchronise in order to achieve the effects desired. However, this aim must be considered within the broader battlespace context envisaged by contemporary warfighting concepts such as multi-dimensional manoeuvre and effects based operations. These prescribe high levels of interoperability and jointness between military personnel and units. Furthermore, they seek to displace older, less dynamic approaches to warfighting with adaptive and agile interconnections. This capacity is assumed to be dependent upon the achievement of a shared situational awareness among those involved. But there are reasons to believe that this shared awareness is extremely difficult, if not impossible, to achieve. Reasons for these doubts include issues of information overload due to the volume of information, time constraints in filtering, assessing and interpreting it, variations in the reliability and quality of the information, and the presence of disinformation and conflicting information. While some possible approaches exist or have been proposed for dealing with these problems, they are not yet well understood or validated. Furthermore, other issues that arise relate to the presentation of information, the willingness of personnel and groups to share information, the potential for misunderstandings and differences of meaning, and readiness to trust and cooperate with previously unknown others.

There are a number of foundational concepts that have the potential to form the bedrock of NCW. Given the emphasis placed on high levels of communication, sharing and mutual understanding between participants, concepts such as communication climate, social learning and learning style appear to have particular application in this context. Use of these concepts may lead to practical means through which the innovation, creativity and problem solving ability envisaged by NCW may be achieved. However, there are a number of remaining issues that must be considered before such benefits can be achieved. Prime among these are the power and political dynamics resident in any organisation, including the military, and factors that limit the extent to which individuals and groups cooperate and collaborate. From the literature considered in this report it would appear that trust plays a pivotal role, underpinning the teamwork, social cohesion and common identity assumed by NCW.

There are a number of organisational models in the literature that represent organisations at different structural and functional stages. These models list the primary characteristics of these stages and map the transformations between them. Three models that have synergies with the direction that the ADF is taking toward NCW are: the Cynefin Model, the Knowledge Warrior Construct and the Carnegie Mellon People Capability Maturity Model. These models have potential utility in defining directions for organisational transformation pathways that address the human, social, political and cultural dimensions of NCW.

It is clear that much research relevant to the focus of this paper is already being done in a variety of areas both within Defence community and elsewhere. It is strongly suggested that an effort be made to better coordinate this work in order to attain maximum benefit from it. Priorities for further research are suggested in the conclusion of this report. In brief, they include: further research directed to the antecedents of trust in an NCW context, and to those factors likely to impact on its ability to be maintained; research into the most suitable organisational structures for NCW; research on a new demographically mixed recruitment pool for the ADF; research on how best to acquire the skills and competency mix required; research into facilitating mixed teams; the plausibility of changing training and educational institutes to promote jointness; structural, organisational and pedagogical effects of training by competencies rather than by services; and research to determine the most effective way to implement the requisite cultural changes in a holistic manner.

Contents

1. INTRODUCTION	1
1.1 Tasks Aims and Objectives.....	1
1.1.1 Scope of the Task	1
1.2 Report Objective	1
1.2.1 Scope of this Report.....	2
2. NEW ORGANISATIONAL PARADIGMS AND NETWORK CENTRIC ORGANISATIONS	3
2.1 The Organisational Context for Network Centricity	3
2.2 Network Centric Concepts and the Military	4
2.3 The Social and Human Influences in the Network Centric Environment	5
3. WARFIGHTERS OF THE PAST AND OF THE FUTURE.....	7
3.1 Warfighting Before and Beyond	7
3.1.1 Value of the Historical Perspective.....	9
3.2 The Transformation of the Military	9
3.2.1 Relevance of the Gulf Wars and Afghanistan	10
3.2.2 Force Mixing.....	10
3.2.3 Resource Management: Promotion and Rotation.....	11
3.2.4 Recruitment and Retention	12
3.3 Future Warfighting Skills	13
3.3.1 Differing Views.....	13
3.4 Implications	14
4. ISSUES FOR INDIVIDUALS AND GROUPS IN FUTURE NCW CONTEXTS ..	16
4.1 C2	16
4.1.1 Intent	16
4.1.2 Self-Synchronisation.	17
4.1.3 Specialisation.....	18
4.1.4 Tempo	18
4.2 Battlespace.....	18
4.2.1 Multidimensional Manoeuvre.....	19
4.2.2 Effects Based Operations	20
4.2.3 Interoperability	21
4.2.4 Jointness.....	21
4.2.5 Adaptability and Agility	22
4.2.6 Reachback and Reach-forward.....	22
4.2.7 Shared Situational Awareness.....	23
4.3 Information	24
4.3.1 Volume of Information	24
4.3.2 Information Sharing and Shared Activities	26
4.3.3 Context, Communication and Signs	27
4.3.4 Reliability and Quality.....	29
4.3.5 Presentation.....	30
4.3.6 Disinformation/Conflicting Information.....	31
4.4 Final Considerations	32
5. LEARNING AND KNOWLEDGE DEVELOPMENT	35
5.1 Organisational Contexts of Interaction and Learning	35

5.1.1	Communication Climate	36
5.1.2	Social Learning.....	37
5.1.3	Preferred Learning Styles	38
5.1.4	Interaction management and knowledge mobilisation	38
5.1.5	Innovation.....	39
5.2	The Social Context and Human Values.....	40
5.2.1	Power and Politics	40
5.2.2	Cooperation and Collaboration.....	42
5.2.3	Trust	42
5.2.4	Teamwork.....	43
5.2.5	Social Cohesion and Common Identity.....	44
5.3	Summary.....	44
6.	ORGANISATIONAL MODELS AND POTENTIAL TRANSFORMATION	
	PATHS	46
6.1	The Cynefin Model	46
6.1.1	The Cynefin Framework.....	46
6.1.1.1	Different ways of viewing the domains of the framework	48
6.1.1.2	Using the Cynefin framework	49
6.1.2	The Cynefin Model and NCW	49
6.2	Knowledge Warrior Constructs.....	50
6.3	People Capability Maturity Model® (P-CMM®)	54
6.3.1	Applying the Model in a Military Context	56
7.	CONCLUSION AND WAY FORWARD	57
7.1	Recurring Themes.....	57
7.1.1	Related Research.....	57
7.1.2	Dominant Recurrent Themes.....	58
7.2	Concerns, Challenges and Considerations	59
7.2.1	Cultural Shifts	59
7.2.2	Organisational and Structural Issues.....	60
7.2.2.1	Workforce requirements.....	60
7.2.3	Required skills, competencies and characteristics.....	60
7.2.4	Integrated Teaming.....	61
7.2.5	HRM policies.....	61
7.2.6	Education and training requirements.....	61
7.2.7	User Friendly technology	62
7.3	Future Directions	62
8.	REFERENCES.....	64
9.	APPENDICES.....	72
A.1.	Appendix: ADF Core Qualities	72
A.2.	Appendix: Emotional Intelligence.....	74
A.3.	Appendix: The Cynefin Model explained.....	79
A.4.	Appendix: Knowledge Warrior Constructs.....	81
A.5.	Appendix: People Capability Maturity Model® (P-CMM®) applied to Situation Awareness.....	83
A.6.	Appendix: Employment of IT Specialists In The Army Reserve	88

1. Introduction

This report is an output from the STR 03/242 Human Dimension of Future Warfighting Task. The task aims and objectives, and the role of this report, are described briefly below.

1.1 Tasks Aims and Objectives

The primary research objective of this Task is to investigate the human factors that need to be considered and supported to make the most of the future Network Centric Warfare (NCW) environment and to understand the related changes that should ideally take place to optimise this form of warfare. Within this context, one of the desired outcomes is to identify the new skills and characteristics that are required by future warfighters.

1.1.1 Scope of the Task

The first stage of this task involved posing and answering the question: What are the factors implicated in 'future warfighting' that are likely to have a major impact on the thought, action and interaction of human participants? There may be a need to identify broad issues like high levels of interdependence (or 'networkedness'), risk, uncertainty, diffuseness of command and control, diffuseness of situation awareness, agility in switching between complex task networks, and/or a need for intuitive rather than prescribed decision-making. Much of this information already exists in the literature, and it is expected that the literature will lead to identifying other relevant issues. The research will largely be conducted at the group level of abstraction.

To progress the task it will be necessary to form an understanding of what a future warfighting environment will look like, at least in broad terms, and what the relevant characteristics of individuals, in groups and in organisations are; it is the intersect between these two spaces that will constrain what is possible to achieve with NCW. It should also be possible to identify points of tension - that is, where the requirements that NCW makes of people may not be how people initially want to think or behave (for example, trusting an unknown other with something we value, for instance, information). This strategy should help identify the "new skills and characteristics" which the future warfighter needs, and the required effort and subsequent value in acquiring them. In the final stages of the research the findings will be modelled in existing, or newly developed, models, as required, and tested in simulated war games.

1.2 Report Objective

This document is an outcome of the first activity in this task, which was to review Defence documents, external literature and relevant DSTO tasks in order to distil the characteristics of the Network Centric environment, and to establish what type of interaction is likely to occur between the future NCW technology and the human and social elements. Therefore

the findings reported herein are largely literature based, although some interviews were conducted and data is also synthesised from this source.

1.2.1 Scope of this Report

The scope of this document includes a review of literature with particular emphasis on:

- the context of NCW for future warfighting, in terms of organisational paradigms and implications for warfighters;
- the commonly accepted characteristics of traditional warfighting;
- the commonly accepted characteristics of future warfighting;
- an overview of current doctrine on NCW and the essential challenges this brings for the human dimension of NCW;
- the consequent considerations for future skill, competency and workforce requirements;
- organisational models and possible transformation paths; and
- possible future directions for this research.

Three potentially useful transformational models are discussed in Section 6. The other issues are examined through sections on New Organisational Paradigms and Network Centric Organisations; Warfighters of the Past and of the Future; Issues for Individuals and Groups in Future NCW Contexts; and Learning and Knowledge Development.

2. New Organisational Paradigms and Network Centric Organisations

NCW is an attempt to translate a business concept of the 1990s into military practice. During this decade, a number of companies attained dramatic competitive advantages in their fields by creating comprehensive, complex communication and information networks. These companies, facilitated by the increasing efficiencies and speed of information technology, remained flexible and adaptable to change. Information and communication technologies (ICT) now pervade virtually all areas of modern society, civil and military. The Internet has connected people and organisations across the world in a way never seen before and the implications for this new connectivity are still being played out and remain to be fully understood. This technology helped companies to make accurate predictions, minimise risk, and adapt rapidly to dynamic circumstances. NCW is the application of this concept to the military. In the military sphere, the term 'network centric warfare' or NCW has emerged as the umbrella under which the implications of ICT and the connectivity it enables for military operations and organisation are argued and assessed. The challenge in this application is to define the ways in which the competitive advantage gained by networked companies can be translated to 'combat advantage' (Army, 2003).

In this section, the organisational context for network centrality is examined, the generally accepted ADF paradigm for NCW is outlined, and the human and social issues of NCW are introduced.

2.1 The Organisational Context for Network Centrality

New organisational forms that are horizontally structured rather than functionally or vertically structured are referred to, variously, as: modular, cluster, learning, network, or perpetual matrix organisations, spinout or virtual corporations (Bartlett & Ghoshal, 1989; Miles & Snow, 1986; Quinn, 1992; Senge, 1990). Regardless of the name, the defining characteristics of these new organisational forms are flatter hierarchies; decentralised decision-making; greater capacity for tolerance of ambiguity; permeable internal and external boundaries; empowerment of employees; capacity for renewal; self-organising units, and self-integrating coordination mechanisms (Daft & Lewin, 1993).

In such organisations, knowledge is the most strategically important resource and organisational capabilities are the product of distinctive competencies in integrating and applying this knowledge. Thus, communication is the pervasive, underlying force responsible for maintenance and dissemination of strategic capabilities based in knowledge. Tucker, Meyer, and Westerman (1996) point out that strategic capabilities result from new knowledge creation accomplished through a combination of individuals' tacit and objective knowledge, yet this collection of knowledge must somehow be aggregated and communicated at a collective level.

2.2 Network Centric Concepts and the Military

In many ways the environment in which the military forces operate does not differ from that of the business environment. The military is characterised by constant change and uncertainty, and exposed to the vagaries of the political and economic climate. Therefore, like other modern organisations, it will require the capacity to deal with complexity and a system that facilitates learning from experiences, continuous learning and innovation in learning.

NCW can be simply described as the style of warfare that is potentially possible when individual combat units are robustly connected by information. If this is achieved, many familiar constraints may disappear as units should become able to interact in many more productive ways than are possible under traditional systems of command and control. In fact, the potential flexibility is so great that centralised command or management, however lightly exercised, is likely to become a limitation. When units know what is going on in the battlespace, and are confident that others do as well, they may be said to have *shared awareness*. This shared awareness may mean they can also give each other mutual support without higher-echelon coordination, fixed physical proximity or prior relationships with each other, or restrictive doctrine. In a network centric environment, there is probably a need for much 'flatter' organisational structures because the role of intermediary coordinating layers may be less necessary.

Force 2020 describes NCW or NEW (Network Enabled Warfare) as follows:

- In the force of 2020, we will have transitioned from 'platform-centric' operations to 'Network-Enabled Operations'. As the name suggests, Network-Enabled Operations derive their power from effectively linking different elements of the organisation to conduct warfare more effectively. Network-Enabled Operations treat platforms as 'nodes' of a network. Since all elements of the network are securely connected, they can collect, share, and access information. This shared information is used to create a common, real-time battlespace 'picture' across all components and all Services, which in turn allows a greater level of situational awareness, coordination, and offensive potential than is currently the case.

The aim of Network-Enabled Operations is to obtain common and enhanced battlespace awareness, and with the application of that awareness, deliver maximum combat effect. The fundamental building block of Network-Enabled Operations is a comprehensive 'information network'. This network comprises a tiered system of 'grids', the most important of which, for our purposes is the so-called "information grid". This is described as "a secure infrastructure that allows information to be collected, analysed and distributed as timely intelligence to provide friendly forces with superior situational awareness. While seamless networks will provide the necessary links between sensors, engagement systems and decision makers, it is the provision across these links of accurate and timely intelligence, not simply information, that will enable commanders to make the right decision at the right time to achieve the desired effect" (ADF, 2003a).

NCW might offer a whole range of warfighting advantages, including the ability to focus limited resources using superior knowledge, increased protection for forces through information, and an ability to share information quickly and securely across current boundaries. However, it also contains potential vulnerabilities, including those arising from reliance on high-technology communications and increased data flows (Defence, 2002b). Furthermore, this wiring together of the force does not guarantee that NCW or its benefits will occur, since network centric warfare as currently conceived by Australia is inherently a behavioural, tactical, bottom-up phenomenon. It entails more than just the possession of large amounts of information. In fact, simply flooding the network with information will, more than likely, ensure that shared awareness does not occur. Information must be absorbed and interpreted by the people within the connected and communicating units, within the broader context of commander's intent, in order for the desired benefits to materialise.

2.3 The Social and Human Influences in the Network Centric Environment

As noted earlier, the network construct was necessitated by the growing rates of change and environmental complexity in which organisations operate, and dealing with these complex problems required the development of flexible organisational structures (Bovasso, 1992; Chisholm, 1996). Such organisational structures are intended to comprise a dynamic system of networks that maximise information exchange between members. In a network organisation, informal social networks should spontaneously emerge in response to a given situation and supersede formal organisational structures, such as those depicted in organisational charts. These networks may involve members, or parties, from different sectors and different levels. This decentralisation of hierarchy is supposed to facilitate a prudent response to unplanned circumstances and offer diverse perspectives on problems through all the available expertise within the network. More importantly, its members, not a centralised source or power, control the network organisation.

To date, much of the NCW related work done by the military has been from a technological and operational perspective; it looks at new possibilities based on the availability of more and better information than ever before, shared understanding and situational awareness, the potential for improved, better informed and faster decision making, and better command, control and coordination of different force elements to achieve the commander's intent. This is, of course, contingent on the fact that the members and units comprising the military force will be operating in an information- and knowledge-rich environment that will enable new or improved capabilities through information sharing and better technology enabled command and control arrangements.

Underlying most NCW discussions there are, however, some important assumptions about how humans and organisational elements will be structured and function in this new environment. For instance, the foundation on which much of the current discussion of NCW in Australia is constructed is that the military force will have largely the same

organisational and command context as currently exists. But, in the context of NCW no less than other technologies, the addition of a new technological capability on the assumption that existing organisational structures, procedures and processes will be able to seamlessly incorporate and make use of it, is at least potentially, a mistake. Conversely, the assumption that any organisational and human changes needed to take advantage of new technological capability will always be achievable is almost certainly equally reckless. Clearly, a close examination of the issues that should be considered is required. This examination commences in the next section of this report with a comparison of what is known about the primary characteristics of past and future warriors.

3. Warfighters of the Past and of the Future

In this section, the commonly accepted characteristics of the warfighter of the past are discussed and compared with current qualities and the expected requirements of the future warrior. The transformation of warfare and its implications for the shape of the future workforce and their education, training, recruitment and retention are briefly outlined. Finally, the perceived constants and essential differences in the human qualities of warfighters of the past and the future are delineated.

3.1 Warfighting Before and Beyond

The World War I ANZAC digger has long stood as a symbol of the early Australian warrior. The original ANZAC was characterised as an amateur, but a natural soldier: courageous and competent, but laid-back and insolent. In the aftermath of the Great War, the Australian Regular Army came to see itself as New Anzacs. The New Anzacs retained the sense of mateship, cohesion and panache, but added a new dimension of hierarchy and professionalism. This new Anzac culture has been durable and robust in the Australian Army, and to a lesser extent in the other Australian services as well, such that it has become synonymous with Australian military culture (Jans, 2002).

However, in the 21st century, while military technology has grown more efficient and more expensive, the maintenance of military forces poses significant financial, management and resource challenges. In response to this, the Australian Army's professional culture is evolving into what Nick Jans calls the 'Dual Professional' culture. The Dual Professional will be required to be all the things its predecessors were as well as having competence in modern organisational management, strategy and bureaucracy (Jans, 2002). Table 1 below, summarises Jans' view of this cultural transition, in terms of a number of cultural metaphors:

Cultural Dimension	Cultural Forms and related Cultural Metaphors		
	Anzac (1914-1945)	New Anzac (1949-1989)	Dual Professional (1990 - still evolving)
<i>Professionalism</i>	<i>The 'natural'</i>	<i>The military artisan</i> (Valued for expertise rather than mass)	<i>Warrior, commander and bureaucrat</i> (Additional roles, rather than changing old roles)
<i>Community</i>	<i>Mateship, unit esprit</i>	<i>Brothers in arms</i> (Accepts outsiders, but only in terms of the institution's values)	<i>Open arms, long tentacles</i> (Much more inclusive, especially women and reserves. Long tentacles keep ex-members within the network bringing back selected members for special continued employment)

Hierarchy	Authority of competence (Follow those who proved themselves worthy to lead)	Chain of command (Organisational and social hierarchy)	Flexible networks (Traditional forms of organisational arrangements when appropriate; more fluid and 'organic' when appropriate.)
Conservatism	Old fashioned Aussie values (pragmatic, introverted, sociable, masculine)	Back to the future (Excessive energy expended in keeping the old ways rather than adapting to the environment)	Dynamic Stability (Intelligent, adaptability; change the things that need to change, keep those that are still functional and relevant)

Table 1. The cultural transition of the ANZAC (Jans, 2002).

In her typology of the Warrior, Nuciari (2003) lists the following essential expectations of warrior types:

- Discipline
- To be fit for action
- Decisiveness
- Leadership
- Obedience
- Ability to undergo physical stress
- Patriotism
- Readiness to make sacrifices
- Loyalty to the civil power.

The Cold War and the Vietnam War brought new concepts of warfighting to military organisations, and since the 1970s, military organisations have increasingly become involved in MOOTW (Military Operations other than War). Certainly, since World War II, the ADF has participated in over 25 United Nations and multinational peacekeeping operations, during the course of which the ADF has earned a reputation for professionalism, technical skill and humanity (Pratten, 1996). According to Nuciari (2003) the characteristics of the peacekeeper are:

- Determination
- Empathy
- Expertise
- Ability to easily make friends
- Co-operativeness
- Mental Strength
- General Education
- Open-mindedness
- Taking responsibility

While there is a definite conflict between some of the elements of Nuciari's two sets of characteristics, she also identifies a third, emergent type which she characterises as "In

Between" or "Flexible", having complementary characteristics from both the Warrior and Peacekeeper typologies, and being the type of soldier who is able to cope with a job that "is not a soldiers' job, but only a soldier can do it" (Nuciari, 2003).

The 1990s and the new century have brought three combat operations in the Middle

East, each with technological refinements that have wrought new changes to the face of war and have involved Australians in MOUT (Military Operations in Urban Terrain). Furthermore, the 'ugly face' of terrorism has brought new meaning to the term asymmetric operations. The warrior of today, therefore, must be prepared to act as a peacekeeper, take part in combat operations, and live and work with ambiguity in an uncertain global environment. There is some evidence to suggest that the characteristics of Nuciari's Flexible Warrior are those that will carry us through this new century.

3.1.1 Value of the Historical Perspective

While the extraordinary technological advances of the last twenty years and the global changes of the past ten years have transformed the conduct of military operations, there is still much to be learned from military history and the lessons of past operations.

For example, DSTO's Land Operations Division's Future Warfighting Studies task (ARM02/066) has recently entered into an MOU with the History Unit at the Australian War Memorial in Canberra to perform a historical study to identify, summarise and analyse 25 engagements deemed relevant to the current and future Australian contexts. The aim is to gain an appreciation of those features that are enduring and those that are emerging. This will support Army's Directorate of Future Land Warfare in the framing and development of Future Warfighting Concepts. However, caution should be practised, as Pratten warns, citing Claus von Clausewitz "...superficial, irresponsible handling of history leads to hundreds of wrong ideas and bogus theorizing" (Von Clausewitz, 1984 cited in Pratten, 1996).

3.2 The Transformation of the Military

The comparisons of the Gulf conflicts in the 1990s and 2003 clearly reflect the transformational character of warfighting. The 1991 Gulf war was characterised by linear lines of operation with distinct phases, and deconfliction of the battlespace by forward planning.

In the most recent war in Iraq, active deconfliction and more discriminating and economical combat power was deployed as well as far more integration of joint capabilities through NCW. The facts and figures for this conflict are only just beginning to emerge but the statistics begin to confirm some trends about discrimination and precision. Spatial precision is now realised on a significant scale - enough to consider it the norm for most targeting. Paradoxically, it is much easier now to generate the wrong effects by weapons missing the target(s), however rare its occurrence, and this places greater stress on accurate information. The strong persistence of capabilities across all environments

provided the key to more responsive targeting. The analysis indicates that air refuelling continues to be a potent force multiplier increasing both reach and persistence and, in conjunction with information sharing, is providing the backbone of tactical responsiveness by allowing the necessary time to deal with the unforeseen (Knox, 2003).

Similar themes emerge with respect to the 2001 conflict in Afghanistan where there was a move toward more flexible and responsive patterns. Unlike in Iraq, air power on its own could not possibly have succeeded in overthrowing the Taliban. Many targets in Afghanistan were dispersed, poorly defined and hard to discriminate and they provided only fleeting windows of opportunity; therefore, new methods of operation had to emerge. The bedrock of responsiveness was the networked operations and competent operation of headquarters that put the weapon carriers in the right place at the right time. The nearest of these headquarters were hundreds of miles away from the centre of the battlespace and some were as remote as the US. The information networking of critical nodes was the key to this responsiveness. But the final resolution and discrimination for targeting was provided by small, mobile land forces that had the secure satellite communications and accurate positional data to cue weapon systems (Knox, 2003).

3.2.1 Relevance of the Gulf Wars and Afghanistan

The two Gulf wars of 1991 and 2003, and the 2001 involvement in Afghanistan, provide the only significant experience of warfare fitting, at least to a certain extent, the tag of "NCW". However, drawing lessons or generalisations from these conflicts may need to be done with considerable caution since, while they exhibit aspects of NCW, they are potentially unrepresentative of future conflicts in that the protagonists were very lopsided in their respective NCW capabilities. A conflict in which the combatants are more technologically comparable with respect to NCW is likely to be significantly different. In the Gulf wars, the Coalition forces experienced little or no interference with their NCW capacity but this is unlikely to be the case in general. Information warfare aimed at effecting or defending against such an attack or interference has been the subject of research and development efforts for some years now. The question, therefore, arises as to what the effects will be on human and organisational functioning in an environment in which the support expected from NCW capabilities may be interfered with, is unavailable or is corrupted in various ways. What happens, for example, to the decision-making ability and decision quality of a commander who, used to operating with sophisticated informational support in an NCW environment, is suddenly deprived of it or has reason to doubt its veracity?

3.2.2 Force Mixing

Future warfare will also involve more collaboration across services, across nations and with civilian and reservists. The Strategic Workforce Planning Review Report (Defence, 2003b) suggests that this workforce mix will be a likely component of future operations. The Review cites the East Timor experience, which, although it was not part of the initial planning, evolved a workforce mix as the operational risk diminished. Substituting

industry civilians and PSPs (Professional Service Providers) for Permanent Force members eased the pressure on sustaining the force, particularly in logistic support. While this model was not applied to recent deployments to the Middle East, the Review suggests it could have been. The report recommends that future ADF exercises include industry participation as a standard part of the planning, including workforce mixing in the area of operations and associated risk management, and contingency and operational plans that include workforce mix options. This workforce mix has implications for the education and training of both the military and their industry co-workers (Defence, 2003b)

If workforce mixing is the way of the future, then training in this way becomes essential. The British have used this form of integration in what they call "force packaging", i.e. modular structures defined as a "series of coherent, self-contained, mix-and-match sets of units borrowed from the various organic commands for a given mission. Such modules can be assembled at short notice to form a mix of force appropriate for the specific demands of unforeseen crisis demanding the use of armed forces" (Dandeker, 1999, p30). This requires serious changes in training and education of military personnel of all ranks. It also requires the development, of 'cultural interoperability', i.e. the development of a joint organisational culture encouraging effective cooperation among different service cultures (Manigart, 2003). While the military has undergone significant change, and will continue to do so, with respect to battlefield operations there will also be continuing transformations in internal and support functions.

3.2.3 Resource Management: Promotion and Rotation

According to Jans (2002), future warfare will be just as much about creative people management, as about creative hardware/software development and application. If the recommendations of the Strategic Workforce Planning Review Report are implemented, there are many aspects of ADF Human Resource Management (HRM) that are likely to change radically over the next 10 to 20 years. It will be a challenge to retain the best of the ADF's traditional personnel systems while re-inventing fundamental aspects of it. This will extend to the 'glue' that holds the mechanical elements together: to things like careers, culture, capability and leadership (Jans, 2001). A major handicap for the ADF, especially senior military officers, is the continual rotation through successive appointments. Jans cites an ADF study that shows that middle level officers' performance improves the longer they spend in a given posting, but that only 15% of them have ever made it through to a third year in a single appointment (even though the CDF, in 1989, ordered that these postings were to be, as far as possible, of three years duration). While the ADF job rotation and posting cycle is a very useful career development strategy, it is not consistent with what best practice dictates, namely that executive stability is an essential factor in developing and sustaining organisational change (Jans, 2001).

Other traditional paradigms may also be less appropriate. For example, the US armed forces are now mindful that their long-term metric for climbing the promotion ladder, largely based on the number of people an officer commanded, is incompatible with future warfighting (Scott, 2003). The military of the future is likely to consist of fewer people,

flatter hierarchies and smaller combat units, so the reward and incentive structures need to adapt, or there will be resistance to these changes. Arthur K Cebrowski has said "Successful transformation hinges on creating a culture of innovation ... that culture must foster leadership, education, process, organisation, values and attitudes that encourage and reward those who embrace innovative risks" (Scott, 2003). To establish a military culture that rewards risk takers and innovators will require changes to established processes in both the US and Australian military, such that HRM and promotion policies reward innovation.

3.2.4 Recruitment and Retention

Recruitment and retention of military personnel are already problematic in the Australian Defence Force. This is only likely to get worse in the future, if current policies and procedures endure. Conventional wisdom has it that not only is the population ageing but younger generations have different career expectations and seem less willing to make long-term commitments or personal sacrifices for their career.

At the global socio-cultural level, individualism and hedonism are becoming central values (Manigart, 2003). The nature of work is changing, the prospect of a job for life has disappeared, and there is greater cultural diversity in the modern world. One of the consequences of this cultural shift is that the pursuit of an individual's personal interests becomes dominant, and the importance of belonging to a larger community diminishes (Manigart, 2003). Some of the indicators of this trend include:

- Individual rights are stressed and duty towards others, or to the nation, is downplayed
- Traditional values based on work ethic, religious values, sense of honour etc are disappearing
- Civil consciousness is disappearing
- People's expectations of work are changing, such that potential soldiers are no longer as motivated by patriotism as they are by their working conditions, and
- There is a decline of trust in institutions, including military and political institutions (Manigart, 2003).

At the demographic level, the growth rate of the Australian population is falling, the population in the 17-24 age group is declining, and male participation in the labour market is falling, particularly in younger age groups where part-time work is increasing at the expense of full-time work (Defence, 2003b). As the traditional pool of people from which the military recruits continues to shrink, the Strategic Workforce Planning Review Report (Defence, 2003b) suggests recruitment strategies should seek to increase the pool to cover parts of the Australian people not yet fully tapped: older age groups, women, non-Anglo Australians and part-timers. Winslow (2003) suggests the military should actively recruit men and women from ethnic minority groups to strengthen the intercultural competencies required for MOOTW and Battlespace operations. It may also be necessary to make better use of military personnel who would otherwise retire, creating a role for them in the future workforce, taking advantage of their considerable experience and military knowledge.

3.3 Future Warfighting Skills

The increasing non-traditional element of the military does not replace its traditional tasks of deterrence and self-defence, but is complementary to them. In MOOW, in particular, traditional and non-traditional roles cannot be neatly separated. Warriors then, will be required to know how to fight, how to establish local security, how to deal with the local adversaries, and how to cooperate with local partners and civilian international relief organisations. In addition to their expertise in military offence and defence, they also will have to be politically educated and to marshal their cultural empathy and diplomatic skills. The warrior will have to develop, as part of his or her professional self-perception as a warfighter, some sort of humanitarian cosmopolitanism that exists besides feelings of patriotism and of national commitment. Globalisation and the emergence of complex interdependence and communication in the world will likely require a new self-perception of the military profession, or at least its substantial extension (Kummel, 2003). The Network Centric Warrior will then be required to deal with war, peace, terrorism and any number of yet unknown situations. They will need additional skills, versatility, adaptability and flexibility beyond those currently expected of them.

3.3.1 Differing Views

In August 2003, a study was conducted to draw out the thinking and views of Capability Systems uniformed staff about working in the Network Centric (NC) environment, their expectations, and what type of guidance they receive to plan for new projects and to run current projects. A DSTO report depicting the outcomes of that study was produced (Hew, 2003) and the issues dealing with the human aspects of NCW are summarised below: On the subject of people requirements, there were two opposing views.

1. New skills and competencies would be involved in a NC environment, with future warriors needing:
 - a good understanding of what their systems could do, of all the capabilities present in the battlespace, and the ability and initiative to apply them to get best effects,
 - the freedom to question, risk, innovate, and learn,
 - the ability to interpret and make decisions on incomplete data, and/or handle being flooded by data,
 - a lot of training to deal with information overload and to think and act differently,
 - the capacity to absorb information and sort the 'wheat from the chaff' (tactical decision-makers will need a broad understanding of all the capabilities),
 - to be allowed to make mistakes and learn from them,
 - a supportive organisational culture,
 - to operate in flatter organisational hierarchies since "The traditional hierarchy saw the commander with the coarse, big picture while the soldier had the

detailed, local picture. In the future, with everyone having access to a common picture, is there a need for a hierarchy? Furthermore, "increased tempo under NCW operations requires devolved control and separation of command from control".

Those who held this point of view believed that it was necessary to give attention to the organisational cultures and working environments that engendered these qualities, with a particular emphasis on the need to flatten hierarchies. Cultural change would be of paramount importance as Defence seeks to take full advantage of networking.

It was further argued that the capacity of its people, coupled to small size and budget, made it both feasible and necessary for the ADF to emphasise people, organisation and doctrine over technology. At this time, doctrine appears to be driven by technology, but technology-focussed solutions were expensive to implement, and adversaries could replicate the technology and thus erode the capability advantage. A number of interviewees pointed out that in the NC environment it should be the other way round, i.e. the doctrine should dictate what technology to adopt.

2. The other dominant point of view was that people issues were already being handled. No extra refinement or development would be necessary. Some skill sets were already present in the ADF – "If you can survive on the Internet, you'll be able to do NCW." – and projects also conducted training needs analyses. Moreover, existing concepts for delegation would handle the flattening of hierarchies.

Research is clearly needed to establish which of these perspectives is most appropriate to the NCW environment.

3.4 Implications

In *Enabling Multidimensional Manoeuvre*, a discussion paper prepared for the ADO Network Centric Warfare Conference held on 20 May 03, it is stated that: "We want NCW to help our people conduct their individual and collective tasks better. NCW will mean that our people will need different skills, but we will always require people to maintain the values that have made the ADF into a distinct and distinctive national institution" (Defence, 2003a). These are the values that the ADF aims to cultivate and which it considers to be vital in combat situations. They are: professionalism; trustworthiness; morality and legitimacy of action; teamwork and initiative; courage and compassion; fairness and respect for the individual; and carefully directed effort (Defence, 2002b). The full text of this part of the doctrinal document appears in Appendix A.1.

In the future NCW context, it may also be necessary to add: collaborative interoperability; cultural empathy; transparency of decision-making; and empowerment of individuals. Furthermore, personality traits likely to be required by an individual may include adaptability and flexibility; being able to make sense out of complex and sometimes contradictory information flows; being capable of dealing with ambiguity and with the lethality and accuracy of the new technology; being comfortable with change, including

cultural change, and with information sharing; having skills in diplomacy and having the ability to innovate.

For NCW to reach its full potential, the ADO must address people issues such as recruiting, selecting and retaining the best people for the future force; cultivating old and new values for the future war space, optimising the operation of people in networks; developing the best possible human-machine interface; and the education and training of the Network Centric warrior, recognising that education is a continuous process while training may be more short-term.

In the following section, doctrinal documents set the context for an examination of the human and social implications of the Network Centric environment for individuals and groups.

4. Issues for Individuals and Groups in Future NCW Contexts

NCW is based on the idea that information is only useful if it allows people to act more effectively. This makes the people in the network fundamental to successful NCW. Ensuring that this human dimension is effective requires attention to important issues such as selection, doctrine, education, training, organisation and the human-machine interface (Defence, 2003a). This raises a number of issues for optimising the participation of individuals and groups within organisations in the future NCW context. Such issues include the handling of information itself, command and control processes and operating in the NCW battlespace. These issues are discussed in this section, in an attempt to draw out the essential human elements that must be taken into account, nurtured and sustained to optimise NCW.

It is first worthwhile to outline the idealised nature and desired benefits of command and control in this new battlespace environment before considering, in more detail, the potential barriers and human-related limitations that might impact their achievement.

4.1 C2

Command and control (C2) under NCW conditions is about conveying, understanding, synchronising the Commander's intent, and managing the battlespace. In particular, it is not only about managing the information for mission command but also about balancing information requirements, as the following quote illustrates: "Mission command is a decentralised command philosophy that seeks to balance the need for commanders to direct operations against the advantage of providing subordinates with the maximum degree of freedom to achieve the commander's intent" (Defence, 2003a).

Furthermore, because networking reduces the significance of the location, the possibilities for cooperation and integration increase. Virtual organisations can bring together participating troops, weapon systems, sensors, decision-makers, and other specialists, as required, for a well-defined task. Virtual organisations, at least potentially, shorten the command and control process and increase the operational tempo, the key element for obtaining a competitive advantage on the battlefield. They hold the potential to reduce the non-productive time in the processes and enable processes to run in a more parallel way than would otherwise be possible (Schulz, 2003).

4.1.1 Intent

A comprehensive description of intent is provided by the Army, in its draft document on Network Centric Warfare (2003) which cites Builder's *Command Concepts*, in defining Commanders Intent:

"Commander's intent, within a NCW context, can be defined as a vision of a prospective operation that informs the making of decisions during that operation. The following is a list of elements that could be found in an ideal commander's intent:

- time scales that reveal adequate preparation and readiness, not just of the concept but of the forces tasked with carrying out that concept,
- awareness of the key physical, geographical, and meteorological features of the battlespace - situational awareness - that will enable the intent to be realized,
- a structuring of forces consistent with the battle tasks to be accomplished,
- congruence of the concept with the means for conducting the battle,
- what is to be accomplished, from the highest to the lowest levels of command?
- intelligence on what the enemy is expected to do, including the confirming and refuting signs to be looked for throughout the coming engagement,
- what the enemy is trying to accomplish, not just what his capabilities and dispositions may be,
- what the intent-originating commander and his forces should be able to do and how to do it, with all of the problems and opportunities - not just the required deployments, logistics, and schedules, but the nature of the clashes and what to expect in the confusion of battle,
- indicators of the failure of, or flaws in, the commander's intent and ways of identifying and communicating information that would change or cancel the concept,
- a contingency plan in the event of failure of the concept and the resulting operation". (Army, 2003)

According to Army (2003) the ideal NCW C2 system will only transmit the information needed to allow the commander to convey his or her intent rather than all the information that can be acquired, or all that the available bandwidth will bear. Although this notion could be said to reflect the ideal situation, it is difficult to see how it can be consistently and universally achieved, particularly in the high stress tempo of combat since it would require personnel who can deal with ambiguous, sometimes overwhelmingly voluminous and, occasionally, misleading information (see Section 4.3 et seq).

While operating within commander's intent is not a totally new concept within warfare (Caforio, 2003; Pratten, 1996), the extent and ubiquity of it within the NCW context is new. What's more, it is probably one of the most problematical of all NCW concepts to deal with, as it requires a paradigm shift in tradition and culture, both for senior officers and junior commanders. It requires devolvement of the locus of decision-making, independence, empowerment and confidence in the decision-makers, and the requisite intelligence and skills for continual self-synchronisation.

4.1.2 Self-Synchronisation.

Again, according to Army (2003): "Self-Synchronisation is the ability of a well-informed force to organise and synchronise complex warfighting activities from the bottom up to meet the commander's intent. The organising principles are unity of effort, clearly

articulated commander's intent, and carefully crafted rules of engagement". Implicit within this definition is a high level of knowledge about not only one's own forces but also enemy forces and appropriate elements of the operating environment.

The increased potential and scope for self-synchronisation will demand leaders who can display initiative in ambiguous environments (ADF, 2003a). Furthermore, self-synchronisation will require leaders and followers who are totally familiar with the appropriate rules of engagement; highly skilled in interpretation of information; well trained in battlespace manoeuvres, yet prepared to improvise and innovate as required; and who are also skilled specialists in one or more additional areas crucial to NCW.

4.1.3 Specialisation

Many military personnel have become ever more specialised as the technology of warfare has advanced and it may be argued that the advent of NCW could add further impetus to this trend. However, another perspective suggests that all participants in a NC force will need to be multi-specialised, so they can turn their hand to whatever individual expertise is required. Additionally, it may emerge that another important characteristic will be intuitive or emotional intelligence¹ that enables military personnel to adapt to different situations, rather than expert knowledge that will only allow them to work expertly in a single specialisation.

4.1.4 Tempo

Contemporary technology facilitates around-the-clock conflict, placing greater demands on commanders and subordinates for speedy decisions and actions. Traditional decision-making methods will, therefore, not always be appropriate or effective. More flexible models of command and control may need to be used. Furthermore, in more intense combat operations, a less hierarchical and more direct command structure will often be appropriate. Similarly, the traditional hierarchical models may still suit other situations (Defence, 2002a). Again, while it is possible to put new protocols in place for 24/7 warfare, it is likely to be the emotional intelligence of the leaders and their subordinates that facilitates the tempo and temperament of C2 in the future battlespace.

4.2 Battlespace

Over the past decade, writers on future warfare have focused much of their attention on identifying the main characteristics of the future battlespace. This process has usually involved isolating a number of dimensions against which comparisons can be made

¹ "Emotional Intelligence" refers to the capacity for recognising our own feelings and those of others, for motivating ourselves, and for managing emotions well in ourselves and in our relationships with others in the workforce. It describes abilities different from, but complementary to, academic intelligence - the purely cognitive capacities measured by IQ.

More information about Emotional Intelligence appears in Appendix A.2.

between the battlespace of the past and that envisioned for the future. For example, the future battlespace is perceived to be much less 'linear' (i.e., predictable) than the past battlespace, demanding a greater level of integration and connectivity between elements than before, and will likely involve a continuity (i.e. a sense of 'open-endedness') that was absent (or indeed excluded) from operations in the past. Clearly, changes such as these would have a major impact on future commanders and military personnel. To begin, such changes would necessitate that junior commanders display greater levels of confidence, initiative and responsibility while commanding, while their senior counterparts attribute to them a greater level of trust in their judgment and capabilities.

While these dimensions may represent dramatic changes in the nature of the battlefield, certain fundamentals will always remain. For instance, the battlespace will always require the effective management of logistics, shift and sustainment, and will inevitably present personnel with uncertainty and chaos. These are core aspects of warfighting which, at the end of the day, are successfully managed by creative and intelligent thinking on the part of military personnel, and not solely by the deployment of technological 'solutions'.

This section reviews a number of dimensions of the future battlespace which have been isolated by writers on NCW and future warfighting. Each is related to one another and therefore should be thought of as operating 'in concert'. Here, each is reviewed in terms of its implications for human thought, action and interaction.

4.2.1 Multidimensional Manoeuvre

Multi-dimensional manoeuvre has been described as a uniquely Australian warfighting concept (Thiele, 2003). According to Thiele (2003), multi-dimensional manoeuvre:

"...sees conflict as a clash of wills as opposed to a clash of military forces and adopts the *indirect* approach of defeating an adversary's will to oppose us... This means that the ADF is not going to try to defeat an enemy by directly engaging and destroying its armed force, rather we are going to consider different and *smarter* ways of resolving the conflict. By matching our strengths against an enemy's vulnerability, we aim to achieve our goals with the minimal use of force" [emphasis added].

Clearly, the concept marks a significant shift in how operations are conceived and executed. The emphasis on smarter and indirect means of influence contrasts with the relatively one-dimensional approach to warfighting of past eras, where the maximum projection of force was highly valued. Furthermore, and unlike past warfare concepts, multidimensional manoeuvre recognises that future adversaries are different and therefore vary in terms of intelligent and adaptive strategies and methods. Thus, the concept seeks to encourage a deeper understanding of the adversary, their perspectives, capabilities, intentions, and of the agents most likely to influence them.

With regard to the demands on future ADF personnel, attention must be drawn to the idea that NCW is believed to be a key enabler of the ability to conduct multidimensional manoeuvre. Hence, multidimensional manoeuvre will require high-levels of information exchange not only between different levels of command, but across government agencies and coalition partners (Defence, 2000). As such, a major emphasis is placed on understanding when and why people will collaborate to share information, and when and why they will not. Clearly, high standards of training, doctrine, and leadership will moderate this willingness. However, attention must also be directed to psychological mediators, particularly the notion of trust, and how it is created, sustained and destroyed (Defence, 2003a).

4.2.2 Effects Based Operations

Force 2020 defines effects-based operations (EBO) as:

“...the application of military and other capabilities to realise specific, desired operational and strategic outcomes in peace and war. In an Effects-Based Operation, our planning focuses on the effects that we are trying to achieve, which allows us to plan our capabilities and operations more flexibly.”

With its focus on effects (i.e. outcomes) and their achievement through flexible (i.e. re-configurable) force packages, EBO is clearly distinguished from past concepts where preordained means-ends relationships dominated.

In many ways, the EBO concept reflects many of the sentiments expressed in the concept of multidimensional manoeuvre. For instance, EBO emphasises defeat of an adversary via understanding their strategy, rather than via attrition of their forces. According to the national effects based approach, this presents a ‘systems’ approach to understanding the adversary, the environment, and their capabilities. Further, EBO calls for the smarter selection of targets, that is, those whose destruction is likely to achieve the maximum benefit insofar as achieving national objectives. Like multidimensional manoeuvre then, EBO demands a better knowledge of the adversaries’ so-called ‘centre of gravity’ (which may not necessarily be military in nature).

According to Army (2003), the greatest challenge presented by the shift towards EBO is the high degree of integration and interaction between people of different forces and agencies. While this is most clearly the case at tactical and operational levels of command, it is vital at strategic levels of command. Here, individual work areas must not only have a working knowledge of their own role in an effects-based operation, but of how their role meshes with other agencies, which may or may not be military in nature. The upshot of this is the requirement for ADF personnel to fully understand the whole-of-government approach as it applies to military strategy and to “develop a more sophisticated understanding, among a wider range of people, of the structures and culture of other countries” (Army, 2003).

4.2.3 Interoperability

It is widely acknowledged that unilateral military activities on the part of the ADF are highly unlikely in the foreseeable future. Instead, the major activities that the ADF conducts in the future will, most likely, be conducted in cooperation with other defence forces, paramilitary forces, and non-military organisations. According to Defence (2003a):

“Interoperability with our allies, regional neighbours and other coalition partners is central to NCW development. In particular, our approach to NCW will ensure that the ADF can provide the Government with a range of military options that can integrate with forces from our closest allied partner, the United States. Such interoperability extends beyond systems and technical aspects to include doctrine, organisation, support and training” (p.22).

In the context of this report, the final sentence of the above quote is highly significant. It draws attention to the idea that one of the most salient dimensions of future warfighting is the demand for Australia’s armed forces to be able to operate effectively with others, despite the fact that these others are likely to differ substantially in terms of their military capabilities, doctrine, and cultural backgrounds. Hence, effective interoperability goes beyond integrated infrastructure and encompasses the social and psychological bases of interpersonal and inter-group cooperation, fundamental to the ability of individuals to work closely together as a group. These ideas have emerged in relation to the preceding dimensions, and direct attention not only to moderating factors of cooperation (e.g. training, education, doctrine) but also to its social and psychological underpinnings (e.g. trust, shared identity, and interdependence is required).

4.2.4 Jointness

For the past decade or so, jointness (or ‘jointery’) has been fundamental to how the ADF arranges itself, both on and off the battlefield. According to Force 2020, jointness (and the so-called ‘Seamless Force’) maximises the ADF’s collective warfighting capabilities and specialisations by drawing not only on the capabilities of the integrated services, but also on the integrated contributions of civilians, embedded contractors, industry personnel, and allies and coalition partners. In doing so, seamless jointness provides the ‘leverage’ to allow a relatively small organisation to accomplish relatively large tasks (e.g. coastal surveillance, peace-enforcement).

Clearly, jointness has a significant conceptual overlap with the notions of interoperability and with the sentiments expressed within the frameworks of EBO and multidimensional manoeuvre. Like these concepts (and particularly the former), there is a growing awareness that jointness has a basis beyond formalisation (i.e. doctrine) and physical infrastructure. Specifically, it has a social and psychological basis that underlies the success of all joint endeavours. This basis lies in a shared sense of trust, identity and commitment amongst personnel, and manifests as effective information exchange and a willingness to engage in cooperative behaviours. To date, however, little research has been

directed toward this level of jointness, and further attention must be directed to the extent to which personnel can be educated into thinking and behaving jointly.

4.2.5 Adaptability and Agility

The terms adaptability and agility seek to capture the *dynamic* component of future warfighting as outlined by concepts such as EBO and multidimensional manoeuvre. Put simply, adaptability refers to the ability of an organisation (or organisational unit) to change so as to better manage (or 'fit') new circumstances or purposes. Agility, on the other hand, refers to speed and ease with which such changes can be made. Of course, the faster and easier this can be done, the better. In military contexts, then, both concepts connote timely flexibility for purpose and are clearly part of the view of future warfighting outlined in Force 2020.

Unfortunately, most discussions concerning organisational adaptability and agility have taken place outside the military arena, where the ability to respond to continual change is considered a critical component of technological and business success. Here, organisations are encouraged to create learning environments capable of rapidly adjusting to environmental change, part of which involves the design of a workforce with not only the knowledge and skills to make rapid adjustments, but also the willingness to acquire new competencies (Curtis, 2001). In short, the adaptable and agile workforce is seen as comprised by people who have been trained to be

- responsive to change,
- robust (i.e. effective under demanding conditions), and
- flexible (i.e. able to utilise multiple paths and methodologies to overcome unforeseen and changing circumstances).

Research attention must examine the extent to which such traits and qualities are selected for and/or educated in the ADF.

4.2.6 Reachback and Reach-forward

Broadly speaking, the term 'reachback' refers to the ability of commanders and other force elements to access valuable resources relevant to military operations (e.g. databank, intelligence, imagery) despite being physically far removed from the information source. A good example of reach-back is outlined by Grant (2002):

"In Operation Enduring Freedom, the commander of US Central Command, Army Gen. Tommy R. Franks, remained at CENTCOM's headquarters in Florida while his air boss - the Combined Force Air Component Commander, or CFACC - deployed forward. Though the CFACC was in south Asia, powerful communications allowed him to tap into data banks, intelligence, and imagery in the United States." (p. 1).

Similarly, the term 'reach-forward' relates the emerging ability of commanders, far removed from a theatre, to use the same infrastructure to manage tactical events that take place in the theatre in real time. For example:

"In Enduring Freedom, Franks or CENTCOM senior staff at MacDill Air Force Base, often granted or withheld approval for tactical execution of a specific strike in Afghanistan" (Grant, 2002).

While reach-back and reach-forward are not entirely new concepts or abilities, they are widely considered to be an increasingly salient feature of the future warfighting context, and resonate strongly with the notion of flexibility resident in the EBO concept and multidimensional manoeuvre, particularly as the supporting technologies become increasingly advanced.

Yet, reach-back and reach-forward also have implications beyond the technological. As Grant (2002) suggests, the selective involvement of higher level and distant headquarters in the tactical aspects of military operations raises questions concerning the command and control of future campaigns. These are large questions, indeed, relating to power and authority relations, the value of 'on the ground knowledge' to effective decision-making, and factors affecting the exchange of valuable information and cooperation between parties, to name but a few. However, the extent to which these human implications have been addressed so far remains minimal.

4.2.7 Shared Situational Awareness

Defined generally, situational awareness is the ability to observe and to determine the orientation of one's own and enemy forces (Defence, 2002b). Shared situational awareness has long been a fundamental pillar of future conceptions of warfighting, being a salient feature of both the EBO concept and of multidimensional manoeuvre. For situational awareness to become a 'shared' commodity, a shared repository of data must be put in place, whereby different people are able to draw on information for their own needs. In the ADF, for example, the technological aspect of shared situational awareness is well illustrated with reference to the Common Relevant Operational Picture (CROP):

"The CROP displays data that, together with doctrine and training, provides the basis for developing a shared understanding of the situation. The data displayed is determined by the individual's need at the time, rather than by direction from above. CROP users will be assisted by 'intelligent agents' that look out for information of interest and alert users to that information." (Defence, 2003a).

However, the ability to achieve shared situational awareness depends as much on social and psychological factors as it does the technology used to present the information of concern. At its very core, the ability to offer personnel shared situational awareness requires effective information exchange and collaboration, as outlined below:

“Shared situational awareness develops as people absorb information, collaborate to understand its implications, and then come to a shared view of the situation at hand. This premise cuts across both the network and human dimensions” (Defence, 2003a).

As such, the factors impacting effective information exchange and collaboration must be investigated insofar as they underpin shared situational awareness. There is a good theoretical base of literature that suggests that total shared awareness is impossible, as each individual will interpret the same thing in a different way. Clearly, this requires further investigation.

4.3 Information

The concept of NCW is based on the connecting together of the elements of a military force so they can readily communicate needed information in real time, or close to it, using software applications built for that purpose. The vision is to use that information to make better decisions, faster, and to communicate those decisions to the executors of them more quickly and precisely than one's adversary. But to achieve this requires not only a capable underlying technological capability but also a highly proficient, well-organised and trained force that is able to take advantage of the resources the technological capability makes available to it. Most particularly, it requires the ability and willingness to discern and focus on what is of importance in the volume of available information, and to trust and share it with others who may need or be able to make use of it.

The essence of the NCW vision is that the technologies and information they can provide and disseminate across and through the military force will allow involved personnel to achieve a shared understanding of the situation with which they are faced, as well as the intent of their force commanders, so that the opponent's vulnerabilities, and any opportunities for action, can be identified and exploited. However, achievement of this vision is not likely to be as straightforward as has sometimes been assumed. For example, issues affecting whether or not this outcome can be achieved include: the volume of information, the sharing of information, the presentation of the information, and the potential for disinformation and conflicting information. Each of these is dealt with in more detail below.

While much remains to be learned, it is already clear that the availability of more and more information through NCW technologies and capabilities will not, of itself, provide any kind of final answer to the problems involved in warfighting. In fact, it is more likely that it may only alleviate or put a new cast on some old problems but at the same time raise new problems of its own.

4.3.1 Volume of Information

Information technologies have advanced to the point where it is now possible to “produce, manipulate and disseminate information ... much faster than we can process it” and

"instead of better enabling a person to do their job [this] threatens to engulf his or her control over the situation" (Edmunds & Morris, 2000). This phenomenon is now well known as "information overload". Other terms referring to the same thing are "infoglut" and "data smog" (Shenk, 1997), and the effect on those exposed and affected by it has been called "analysis paralysis" (Stanley & Clipsham, 1997) and "information fatigue syndrome" (Oppenheim, 1997). Four major factors have been found to contribute to information overload: the sheer volume of information, the difficulty or impossibility of successfully managing it due to time constraints, the irrelevance or unimportance of most of it, and the multiple sources from which it arrives. However, it appears that the volume of information (Farhoomand & Drury, 2002) and the time pressure aspect (Kock, 2000) are the most important.

NCW is predicated, as has been noted, on the connection of military force and supporting elements together to enable, as far as possible, unhindered information flow between them. It seems clear that this will result in vastly more information for military personnel and commanders to handle than ever before. This, combined with the often significant time pressure on military personnel to reach a decision, means that the issue of information overload of these personnel will become ever more important. Indeed efforts to understand the implications of this problem in a military environment have been, and are still, a topic of significant research interest (e.g. Entin et al, 1997; MacDonald & Oettinger, 2002).

In their study of information overload, Farhoomand and Drury (2002) find that filtering is the most commonly suggested solution to the problem. But the obvious question is 'how'? Any kind of automated filtering assumes that it is possible to identify what would be interesting, relevant or important in the information beforehand but in a typically unstructured, confused and chaotic military environment this is unlikely to be possible in general. On the contrary, loading the responsibility for filtering onto personnel trying to cope with other demanding tasks, such as understanding the information and deciding how or if to act upon it, is unlikely to work well either. Perhaps, therefore, there is a need for a dedicated new role - a person whose job it is, and who is trained specifically for the task, to scan incoming information for anything that might possibly be unusual, interesting or important in the incoming stream and pass it on to others for consideration, analysis and decision. That is, someone whose job amounts to being responsible just for picking out things and in effect saying "that's odd; you might want to take a look at it". This might counter the two major factors in information overload - volume and time constraints. First, volume could be coped with better because the responsibility would not be to assimilate the incoming information, just to note unusual features in it without any further analysis. Secondly, the time constraint would be alleviated because that is all such a person would be required to do. No other demands would be made of them. As an example, a whole range of oddities were individually known before the September 11, 2001 terrorist attacks (like people learning to fly airliners but who weren't interested in learning how to land them) that, if picked out and aggregated, would very probably have enabled prediction of the attack. But no one was tasked with picking out these oddities, just because they looked interesting, for others to analyse.

4.3.2 Information Sharing and Shared Activities

With wider use of technologies to achieve routine or programmed tasks, the dynamic of human productivity in organisations has shifted into a 'meta-realm' of shared activity. Daneshar (2003) notes that, in such contexts, it is not only what a person knows that is important but also what they believe should be shared, when, how and with whom. Thus, for most participants in such systems, the notion of awareness needs to be extended to include the emerging new roles that involve attending to the needs of other participants and related communication responsibilities. Other features of this 'meta-realm' include advanced strategic cooperation and increased communication aimed at shared applications of a range of knowledge emerging from more complex and often more intense experiences (Crawford, 2003).

The new contexts often involve the management of large amounts of data and rapid decision-making among people who are not necessarily based in the same location, and have not necessarily had similar experiences. People with particular perspectives, knowledge or information have a responsibility to share with other stakeholders. The contexts also often involve interpreting and acting on data, sometimes about other people, that has been obtained using machine capacities beyond human sensory capabilities. The shared human tasks in such a setting require an expanded set of individual (and group) capabilities that include:

- Defining the problem and collectively refining the objective of the shared activity,
- Scoping and reviewing the factors involved and interpreting available information and providing feedback and advice to other members of the group,
- Choosing, debating and designing a provisional shared overall strategy,
- Selecting provisional practical tactics to achieve the shared objective,
- Implementing provisional operational processes that have been decided on by the group,
- Evaluating the results, the incoming data, the changing context, the emerging governing variables, learning from the ongoing experience, and revising the human activity accordingly (Crawford, 2003).

In such settings, much of the routine activity of the tools is networked and machine-to-machine interaction is usually outside the immediate awareness of people. In complex and rapidly evolving settings, with a high technical component, it is already recognised that operational styles and capabilities to carry out routine instructions obediently, accurately and without reflection, are less in demand than in former eras². Recent research indicates that new technologies are interpreted and used differently, with varying benefits by

² The OECD Growth Project reported that employment growth of knowledge workers grew significantly faster than that of other occupations during the period 1992 – 1999. OECD, *The New Economy: Beyond the Hype*. Final Report on the OECD Growth Project, 2001.

people with different styles (Crawford, 2003) (see section on Learning and Knowledge Development).

Fundamental to discussions of NCW is the assumption that the implementation of ICT to connect operational level force elements together and link them to higher command levels will result in the availability of "a fused picture of *relevant* information and analysis, provided in a *timely* and *prioritised* fashion" (ADF, 2002a). Moreover, it is then argued that force elements will be able to "self-synchronise" because they are able to "share information and (more importantly) quickly develop shared *understanding* [and therefore] adapt to changes in the situation faster". While it is recognised that this will require "both cultural and organisational change", it is assumed that such change is possible and feasible. Arguably, however, there are reasons for caution in anticipating such an outcome.

Many modern organisations are critically dependent on their data and information resources for effective and efficient operation. For example, Beynon-Davies (2002, p435) says "Information is a critical resource for organisations, particularly in modern information societies and economies" and consequently, as Applegate, Austin and McFarlan (2003, p1) note, "IT has become a strategic part of most businesses". There is, thus, a considerable parallel here with the military context and the aims of NCW. But such availability implies a willingness to share on the part of those who have the data or information concerned.

Despite the claimed benefits of sharing data and information in organisations, and the undoubted and ever increasing capabilities of ICT to enable it, sharing evidently remains remarkably difficult. For example, a decade or so ago Davenport et al (1992) said that "the rhetoric and technology of information management have far out-paced the ability of people to understand and agree on what information they need and then to share it [so] the information-based organisation is largely a fantasy" and, arguably, the situation has not changed much since. Kendall & Kendall (2002, p73), discussing the management of e-commerce projects, say "organisational politics can come into play, because often units feel protective of the data they generate and do not understand the need to share them across the organisation". Evidently, motivations for sharing data, information and knowledge – or perhaps even more importantly, motivations for *not* sharing (e.g. Hart, 2002) – need to be better understood than is currently the case, if the claimed benefits of NCW are to actually be achieved.

4.3.3 Context, Communication and Signs

It is not infrequently said that information is data in context. But the question immediately arises as to *whose* context? All communication occurs through the use of *signs* and, very often in the case of humans, specialised signs termed *symbols*. The study of signs and symbols is called semiotics, an area that has been of increasing interest in information systems research over recent years (e.g. Ramprasad & Rai, 1996; Liebenau & Harindranath, 2002).

Signs or symbols are always part of a "system of signification" that gives them their meaning. The importance of this is that "one agent may intend some signals [signs] to convey one meaning but the receiver takes them to mean something else, or fails to derive any meaning from them at all" (Benyon, 2001). Moreover, the risks of this happening are increased because:

"The new forms [of information and communication technology] multiply the capacity for information generation and dissipation; more people have access to the same stimuli to generate information, and more people can act upon the same information and dissipate it [to others]. As such there is increased scope for conflict as well as cooperation in interpreting the stimuli and determining the action to be taken based on the information" (Ramprasad & Rai, 1996)

NCW arguably has much in common with organisational decision support systems (ODSSs) in that both are focussed on the communication and coordination function in the organisation and include "all systems that provide "borderless" and "seamless" decision-making support across functional, divisional and national boundaries" (Liebenau & Harindranath, 2002). They therefore face at least some similar issues, including, for example, the fact that often "group representatives tend to operate in an organizationally sub-optimal way as their first loyalty is to their own groups rather than to the organization" because different contexts and the resulting perceptions will often "conflict with one another, despite an overall shared organizational goal" (Liebenau & Harindranath, 2002).

Signs/symbols can be viewed on at least four levels, the last three of which are well known as sub-fields of linguistics:

- Physical and Empiric – the physical patterns that make up the sign,
- Syntactic – the rules for correctly connecting signs into larger structures (e.g. letters into words, words into sentences),
- Semantic – the meaning of the sign,
- Pragmatic – the action implications of the sign.

All of these levels are important because, ultimately, the intention of communicating and using signs to do so is, in many, if not all cases, to generate some effect through appropriate action. In the example "It is hot in here", "here" is a sequence of marks on paper but could also take the form of an utterance as a sequence of sounds. Either way, this is the sign considered at the empiric level. At the syntactic level, the sequence of letters and words is correctly formed, in a way that "thh reenisit s io" or "in is here hot it" are not. This is the sign considered at the syntactic level. At the semantic level, the sign is a statement of the temperature in the local environment – its literal meaning. Lastly, at the pragmatic level, the action implication of the sign is highly dependent on the context in which it exists. It could, for example, carry the action implication of a request to open a door or window.

As Stamper (1992) notes, computerised information systems, such as NCW systems, support the capture, storage, retrieval and dissemination of signs at only the lower (arguably physical and empiric to syntactic) levels of this "semiotic ladder" but do not deal with the higher levels at which meaning and intent enter, and at which context is ever more important to the sign's effects. It cannot, therefore, be uncritically assumed (as much of the current discussion of NCW tends to do) that the provision of however much information will actually result in "shared understanding" or a "Common Relevant Operating Picture" as the basis of decision-making regarding actions to be taken.

4.3.4 Reliability and Quality

Reliability can be a crucial information attribute, and is quite different from accuracy with which it is sometimes confused. For example, in comparing the early days of radio with the still early evolution of Internet communication technologies, Hargittai (2000) describes the situation of the Titanic in which "messages sent to the mainland [by the sinking vessel] were intercepted and mixed indiscriminately with other messages by amateur users, leading to information that made it seem the ship was heading safely towards the coast" which, of course, it was not. In this case, accurate information was there but buried and mixed up with other probably equally accurate material, in such a way that the received message bore no relation to actuality. As eventually understood, the information was not reliable and, although this was almost certainly unavoidable anyway, the ship was lost along with most of its passengers and crew.

Stair and Reynolds (1998) say "Reliable information can be depended on". But reliability is a function of several factors other than the accuracy of the information itself. As in the example of the Titanic, combining (even accurate) information from different sources in ways that may seem obvious at the time but which in fact are inappropriate can be disastrous. And, beyond that, the collection method and source are also important reliability issues since, even if the information is completely accurate, if either of these is regarded as suspect for any reason then so also will be the information sourced through them.

Information reliability is an aspect of information quality. But "although one can ensure the quality of data [from which information is derived], it is often hard to control for the quality of the information" (Sen, 2001). Moreover, the reliability and quality of a piece of information are not fixed since the information may be used for a variety of different purposes and, for some of these purposes, it may be of an entirely adequate reliability and quality but, for others, not. Reliability and quality are, therefore, relative to intended use and are not absolute measures applicable to information independently of its use context. But herein lies a dilemma. It is difficult, if not impossible, to predict *ex ante* how information might be used in a NCW environment (even more so than in a business environment, which is difficult enough) and therefore to rate its reliability and quality for these potential purposes. But, on the other side of the coin, the uses to which information might be put are themselves at least partially dependent on the reliability and quality it is assessed to have.

NCW discussions often talk of a “Common Relevant Operating Picture” or an equivalent concept. But is it possible to have such a thing? The purposes to which an operating picture is to be put determine not only what information is relevant but also what counts as reliable information, of appropriate quality, to incorporate into it.

According to English (2001) quality information has the following characteristics. It:

- is the right data/information,
- is complete,
- is in the right context,
- has the right accuracy and objectivity,
- is without redundancy,
- is in the right format,
- is at the right time,
- is at the right place,
- is for the right purpose.

This, however, rather begs the question of what is “right” and how this should be judged given that what is right depends on the purposes the information consumer has in mind and also that purposes, in fluid and ambiguous circumstances such as warfighting, are often emergent in light of the information available at the time. Indeed, it has been argued that the focus on information first, separately from the questions it might potentially answer, is unbalanced and that a “question-centric” rather than an “information-centric” approach has significant advantages, such as a high tolerance for ambiguity (Lauer, 2001). So, which comes first: right (i.e. reliable, high quality) information, or purpose and its associated questions? Or, if neither (or both), how is this joint dependency to be managed and supported?

4.3.5 Presentation

The way in which information is presented has important effects on how it is received and the effects it has. In particular, the communication medium used has been argued to have effects on levels of cooperation and trust between the communicating parties, although there is also evidence that this can depend on the cognitive styles of the consumers of the information as well (Barkhi, 2002).

Communication media can be characterised according to their “richness” and media richness theory argues that various kinds of media differ in their ability to convey information and to change understanding within a given time interval (Daft & Lengel, 1986). The richness of the medium is based on four criteria: its level of feedback, multiple cues, language variety and personal focus. Face-to-face is regarded as the richest communication medium, and computer-mediated communication is leanest. Moreover, the task-media fit hypothesis (McGrath, 1991) proposes that the nature of the task being undertaken and the richness of the communication medium involved interact and affect the effectiveness with which the task is performed. The hypothesis says, for example, that different kinds of tasks range in the potential communication richness required for

success. In order of increasing required communication richness, the task types and their preferred media are (McGrath & Hollingshead, 1993):

- generating ideas and plans – computer systems,
- choosing correct answers; intellectual tasks – audio or video systems,
- choosing preferred answers; judgement tasks – audio or video systems, and
- negotiating conflicts of interests – face-to-face.

The tasks that must be performed by military personnel, whether in an NCW environment or not, range across all of these types and, while empirical support for the task-media fit hypothesis has been mixed (e.g. Mennecke, Valacich & Wheeler, 2000), it seems clear that it is important to take issues of this kind into account when considering how to design and operate an NCW environment, and how to train personnel in its use. In particular, it seems evident that it will be necessary to provide for information to be presented in different ways and at different levels of abstraction to suit the kind of task being undertaken, as well as the users requirements and cognitive preferences.

4.3.6 Disinformation/Conflicting Information

“In moving to battlespace command and control based on a Common Relevant Operating Picture, there is a requirement for the continuous validation of the information presented. It is unlikely, however, that this can be achieved and consequently not every element depicted will be 100% accurate. The ADF's training and education processes, therefore, must emphasise that perfect situational awareness is unattainable and must permit and allow for periodic failure in the interests of learning about decision-making in ambiguous circumstances” (ADF, 2003b).

Disinformation is so-called information that has been “manipulated or ‘created’ to provide the target or its environment a perception that develops behaviours beneficial to the attacker” (Hutchinson & Warren, 2000). The kinds of effects an adversary may set out to achieve through its use are typically:

- to undermine the cohesion, coordination, cooperation and effectiveness of the opposing military force by sowing confusion and doubt in the minds of its members, and
- to misrepresent the situation with which it is faced and therefore to encourage inappropriate or unproductive behaviours.

A famous example of the latter strategy was the creation by the Allies in 1944, of a dummy army, including phoney communications between and about the dummy elements of the force, opposite Calais in France, in order to direct the attention of the German defenders to that area and away from the actual landing beaches in Normandy; this disinformation strategy turned out to be highly successful in the end.

Disinformation works best when it is not seen for what it is. That is, when the consumers credit it as being, at least potentially, 'real' information. Even so, disinformation can still be effective even if this is not the case. For example, if those who consume and depend on the information stream suspect that *some* of what they are receiving may have been interfered with, falsified or created to deceive, but do not know *what* has been so affected, then they may be led to doubt *all* or at least substantial portions of the information. Moreover, it may be that the information itself has not been compromised; it being sufficient to cast doubt on its origin or source to create the desired confusion and doubt.

Even in the absence of interference with information by the adversary there may be conflicting or dissonant information. Military operations are often, if not always, accompanied by high levels of uncertainty, confusion and ambiguity and it is thus almost inevitable that a certain portion of the information obtained or reported will be (unintentionally) false, mistaken or misleading, or inconsistent with other information. Indeed, as the number of interconnections between force, command and support elements increases – and NCW aims to connect all or at least most – this is more and more likely to be the case.

The question, then, is not how disinformation and conflicting or dissonant information can be avoided. They will always be, or potentially be, present. Technologically based methods can only ever reduce, not eliminate their occurrence. Rather, the issue is how they can be dealt with successfully by the human information consumers and decision-makers with the least disruption to the successful functioning of the military force. A related risk, in an information intensive NCW environment, is the temptation to wait for, or pursue, a complete picture of what is going on – to attempt to identify and eliminate any disinformation that has crept in, to reconcile any conflicting information and to wait for the 'one last piece' of the jigsaw that will make it all come clear. This can lead to self-induced decision paralysis and is a reflection of an addiction to information based on the assumption that it is possible to have what has been called a 'transparent' battlespace. But this is unachievable, and care will have to be taken to train personnel operating in an NCW environment so they can strike an appropriate balance between the information they regard as essential to have before making a decision, and that they judge they can do without. The best commanders know when they know enough to go ahead.

4.4 Final Considerations

Recent developments in the military environment of the Western world have clearly influenced and will continue to influence the military organisational structure. Military organisations, like their civilian counterparts will have to develop new, more decentralised structural forms, with more open boundaries and flatter hierarchies. The old traditional, centralised and routinised structures, that were suitable for relatively stable and predictable conditions, will have to be replaced by flexible organisations, better adapted to the new, uncertain and changeable environment of the new century (Manigart, 2003).

In terms of information demands, command and control and operating within the NCW battlespace, the primary issue is sense-making: "Once an understanding of a situation that requires attention has been reached, individuals and organisations engage in a process best known as sense-making, in which they relate their understanding of the situation to their mental models of how it can evolve over time, their ability to control that development, and the values that drive their choices of action" (Alberts, 2001). Once the sense-making process has resulted in a number of possible alternative actions, a set of criteria for evaluating the alternatives and an assessment of the alternatives, a decision can be made. However, many military decisions, particularly in the NCW context, involve considerable uncertainty, new situations and novel features that require innovative thought and sense-making in the cognitive domain. Research has shown that, in the military domain, complex decisions are best made by small numbers of individuals who have different backgrounds and different perceptions of the situation (Alberts, 2001). These analytical processes are often performed quickly, even subconsciously, by individuals, but, in a NCW context, shared sense-making and shared decision-making can become a crucial part of the process.

Two main themes emerge from a review of the future battlespace, both of which offer directions for future research efforts and organisational changes. The first of these concerns the mechanism whereby *influence* is exerted in the battlespace. In the future battlespace, an adversary is influenced as much by non-military (so-called 'indirect') means as by traditional military means. Indeed, these indirect means may involve elements of the adversary's own landscape (e.g. their domestic politics). Clearly, this shift in focus requires ADF personnel to be equipped with a greater knowledge of a given adversary's perspective so as to be able to identify the factors having the most leverage over them. Such an undertaking would involve a major transformation in how ADF personnel are trained to conceive military operations.

The second theme pertains to the fundamental importance of human cooperation. The future battlespace will demand that personnel cooperate to a far greater extent than ever before. Yet, the factors affecting the achievement of this outcome are more social and psychological in nature than they are technological. For that reason, efforts must be made towards understanding the psychological underpinnings of interpersonal and inter-group cooperation in military contexts through a program of systematic research, with a view to determining the necessary changes in the training structures of the ADF.

Development of confidence, initiative and trust rests on education and training about Mission Command from the earliest stages of an individual's career. Military activities that place a heavy emphasis on unthinking obedience will be counter-productive to the development of initiative and trust. Ideally, all participants in a NC force will need to be: skilled, confident, adaptable, intuitive, innovative, independent, always mindful of the Commander's intent, and good at building and sustaining relationships in the workplace. These characteristics are synonymous with those displayed by people with a high emotional intelligence index.

Successful exponents of emotional intelligence prepare by immersing themselves in the problem and information, incubate the information and possibilities, illuminate solutions and take action, even if it requires dogged persistence despite objections, setbacks and failures along the way. People with a high emotional intelligence index have a drive to achieve, commitment to the organisation's vision and goals and initiative and optimism. They have 'the ability to be flexible, to take in new, even painful information without tuning out in self-protection, and to respond nimbly'. They know that 'an accurate understanding of the formal organisational structure is not enough, that what's needed is a keen sense of the informal structure and the unspoken power centres and they realise that 'building relationships creates a reservoir of trust' for the future (Goleman, 1998a/b). Fortunately, emotional intelligence is a learned capability and, as such, should become part of the education and training of the Network Centric warrior.³

However, it should also be acknowledged that social contexts and human values support and constrain successful engagement in NCW, and these issues are discussed in the next section.

³ More information on Emotional Intelligence appears in Appendix A.2.

5. Learning and Knowledge Development

The Network Centric Warfare Roadmap suggests that periodic overarching reviews of ADF training and education content will be needed to ensure any changes in the implementation of NCW are reflected in training and education regimes. The Roadmap further stresses that doctrine must be periodically reviewed to ensure continuing relevance (ADF, 2003c). While there is no doubt that these are important considerations and steps should be taken to implement these reviews sooner rather than later, much more needs to be addressed to institute an effective and enduring learning and knowledge development climate that will carry the NCW warrior into the future. Other considerations include setting up a supportive organisational context for interaction and learning, such that a favourable communication climate is created, professional mastery and social learning are supported, individual variations in temperament and learning style are accommodated, interaction is actively managed, knowledge development is actively mobilised, and innovation is encouraged, nurtured and implemented.

5.1 Organisational Contexts of Interaction and Learning

The widespread application of information and communications technologies (ICT) has generally increased the complexity of human workplaces and has placed new demands on the thinking and communication of individuals. In such contexts, traditional rational systematic processes have limitations and greater demands are made on meta-cognition and intuitive thinking (Woodhouse, 2000; Crawford, 2003). Solving complex problems usually involves teams of people with effective communication between themselves and with those people who will be affected by the emerging solution.

Another feature of complex contexts is evolution and change. Changing contexts place new and ongoing demands on creative and strategic adaptation. In such contexts, pressures exist to pay attention to the shared experience, understanding, and emerging knowledge among participants. There is also a need for debate and discussion aimed at revising collective knowledge and beliefs (the culture) as the context changes or new factors emerge (Crawford, 2003).

The expansion in activity brought about by complex contexts brings with it a shift from a focus on individual activity towards greater expectations for cooperative and shared experiences in changing contexts. Whilst the change towards cooperative activity is essential for community adaptation and efficiency, more importantly it is essential for ongoing individual learning and development. More specifically, greater emphasis on collective development, enabled by new ICT, involves:

- greater expectations for sharing of experience and actions through communication,
- more intense engagement in cooperative activity to manage adaptive pressures, and governing variables, and to develop a shared understanding of a complex and evolving task,

- more dynamic patterns of applied knowledge making in addition to information sharing, involving argument and reflective practices,
- cooperation and activity extended across previously separate locations and between groups involved in dissimilar activity,
- these changes reflect the intuitive human response to a shift from very simple, localised power structures and broadcast modes of information sharing along hierarchical lines, to much more complex systems of networked interaction involving shared risk, responsibility, interpretation and decision making (Crawford, 2003).

Another major emerging trend in organisational contexts is a lessened focus on routine, and greater demands for intense engagement and communication. There is an increased requirement to engage more intensely in managing, interpreting and sharing larger, complex amounts of data and demands for rapid and coordinated group decision-making. This, in turn, makes far greater demands on thinking, personal initiative, learning and communicating, and on flexible, creative, and often intuitively based problem-solving capabilities (Crawford, 2003).

5.1.1 Communication Climate

Communication is an essential element of all collective human activity. It facilitates learning, it helps build effective teams and it contributes to the development of individual knowledge bases. In this way, it also is a foundation for successful decision-making.

The objective of a network centric environment is to maximise the usefulness of information and expertise held by different parties within a group. Traditionally and historically, people have disseminated information through one-on-one processes. In contrast, a network centric operation permits instant distribution and utilisation of information to everyone in a network, regardless of proximity. However, meaningful dissemination of information depends on people's willingness to share and receive information. In this relationship of interdependencies, communication and trust play vital roles.

The overall organisational culture or climate is greatly influenced by the prevailing communication behaviours. Organisational climate can be described as the "internal social psychological environment" or the "shared, holistic, collectively defined social context" that has emerged within the organisation over time (Denison, 1996). There is evidence that the more favourably perceived the climate is, the higher will be levels of organisational commitment; that is, employees will demonstrate a strong belief in and acceptance of the organisation's goals and values; a willingness to exert considerable effort on behalf of the organisation; and a strong desire to maintain membership in the organisation (Guzley, 1992).

The literature on communication differentiates between supportive and defensive communication climates. Supportive climates are characterised by open exchanges of

information and the use of constructive conflict management procedures, and an overall culture of interacting in a confirming and cooperative manner. In the network centric organisation, communication climate is important because of its impact on information sharing, and openness, generally, and on organisational members' levels of commitment to the organisation. If the communication climate is to be one that fosters knowledge mobilisation, then there must be:

- communication opportunities so that open exchanges of information can take place,
- trust between organisational members so that there is a willingness (or at least a perceived lack of threat) to openly exchange information, and
- a perception that exchanging information is the norm (or at least not highly unusual).

While one of the primary concerns of NCW has been developing the communication channels, there has been very little research done on what impact these changes may have on learning and the development of knowledge for individuals. A myriad of factors impact on successful learning, and some of the more fundamental issues are discussed below.

5.1.2 Social Learning

In work life, socially based learning occurs all the time and in ways not often recognised as learning (Jordan, 1996). "Situated learning" refers to the learning that occurs from the interactions between people and the environment (Lave & Wenger, 1991) while "social learning" is a more applied concept and refers to the learning that occurs within a group, an organisation, or any cultural cluster and it includes:

- the procedures that facilitate generative learning - learning that enhances the enterprise's ability to adjust to dynamic and unexpected situations and to react creatively to them, and
- the procedures by which knowledge and practice are transmitted across posting cycles, throughout time and across different work situations (Warne et al, 2002).

The overarching organisational values that have been found to most effectively support social learning include the following:

- empowerment (where empowerment of staff also makes them accountable),
- trust (which entails mutual respect),
- forgiveness (in terms of allowing personnel to take reasonable risks, forgiving mistakes and facilitating knowledge construction on the basis of lessons learnt),
- cultural cohesiveness (in terms of common identity, shared goals and a shared understanding),
- commitment (which includes a mutual commitment and loyalty from the employee to the organisation as well as the organisation to the employee),
- openness of the decision-making process, and
- a culture of information sharing.

From a cultural perspective, social learning is enabled by consistent, guided enculturation leading to a common identity with a common language, a shared vision and shared objectives facilitating information and knowledge sharing, which is built on trust. To maintain this supportive culture requires strong, but nurturing leadership, an open and supportive communication climate, and conditions of service that can be seen as the organisation's reciprocal loyalty to its staff.

An NCW environment entails the interaction of multiple and diverse groups and individuals who need to successfully learn from each other in order to cope with the demands placed upon them. Therefore, an understanding of the issues involved in such learning is an important aspect impacting the success of NCW operations.

5.1.3 Preferred Learning Styles

Learning style relates to the manner in which individuals process information. In recent research, awareness of thinking, or meta-cognition, has been argued to be an important component of this ability (Wenger, 2002; Langer, 1997).

NCW challenges some of the traditional approaches to human learning. It implies a shift from operational compliance to a focus on personal interpretation, initiative and meaningful activity (Crawford, 2003). Thus, there is inconsistency between the ethos of NCW and the traditional way of organising which supports:

- a very narrow focus on operational performance with an elite doing most advanced thinking (e.g. problem definition, strategic development, tactical decision making, mediating and evaluation of outcomes), and
- rational and analytic thinking over intuitive thinking.

Given that network centric warfare attempts to provide the collaborative and shared situational awareness which supports effects-based operations, the importance of acquiring a more thorough understanding of human learning behaviour and human interaction cannot be underestimated.

5.1.4 Interaction management and knowledge mobilisation

In complex situations of rapid and often high-risk change, such as are often encountered in military operations, effective knowledge management and knowledge mobilisation may be a matter of life and death. The discussions above suggest that effectiveness can be improved in a NCW environment through purposeful steps to:

- acknowledge and respect the different needs and capabilities of people with ,
- recognise that the people with different learning styles will be enabled to different extents by any 'one size fits all' technical environment,
- recognise that technical tools are more rigid in carrying out routines than the people who formerly carried out such tasks – ensuring automated machine based operations are also investigated and reviewed as well as human performance,

- recognise the new demands of more complex socio-technical settings in which people operate and the new capabilities that will be strategic assets to any team,
- create, make explicit and support rules, roles and patterns of authority and responsibility that are appropriate to the kinds of thinking and informal learning required by all people in complex and changing contexts,
- promote rapid mobilisation of shared knowledge,
- in complex and/or changing contexts, enhance opportunities for people to communicate, debate, critique, question, co-invent, experiment and critically evaluate and modify provisional solutions,
- engage in reflection and review about the strategic effectiveness of the evolving patterns of activity, and deployment of human capabilities of different kinds, and the match between these and the demands of the evolving context,
- recognise that many people will need to actively share in the decision making and negotiations around complex, evolving activities to develop and strengthen their new capabilities and to identify with the strategic purpose of the new kinds of thinking, learning and communication (Crawford, 2003).

5.1.5 Innovation

In an NCW context the ability to create and implement innovative solutions to complex problems is likely to be even more paramount than in traditional warfare. The relationship between trust and innovative effort is an established one, in the management, organisational communication, and knowledge management literature. This literature discusses the necessity of supportive organisational contexts for interaction and learning if workers are to be prepared to expend innovative effort. Innovative effort beyond that gained from simple financial incentives or contracts requires trust, because only trust can assure employees that if their new ideas fail they will not be overly penalised (Hosmer, 1994).

The consensus is that simple employee cooperation is no longer sufficient for attaining the flexibility needed in today's increasingly competitive environment (Hosmer, 1996); commitment and diligence are now essential to innovation efforts and are required before talent, ingenuity and knowledge come into play (Drucker, 1998).

Vandenbosh et al (2001) address the role of individual differences in generating ideas. They posit that there are five archetypes of idea generation behaviour. Each archetype is based on individual approaches to:

- acquiring information (e.g. to search with a predetermined agenda, or scan with a broad agenda),
- managing change (e.g. likelihood to maintain the status quo, react to the problem, or initiate change in order to increase capacity to influence the environment),
- relating to others (e.g. tendency to direct others, mediate by empowering others, collaborate with others, or internalise), and
- solving problems (e.g. to retain by focusing on ideas that complement and affirm one's own approach, to converge by closing in on ideas to find an agreeable

solution, or to diverge by expanding on many ideas to develop a specific solution, or to debate, by dialectic discussion of several ideas, to develop a specific solution).

	Leibniz	Locke	Kant	Hegel	Singer
Information Acquisition	Searching	Searching	Scanning	Scanning	Scanning
Approach to change	Maintaining	Reacting	Initiating	Initiating	Initiating
Relationships with others	Directing	Mediating	Collaborating	Internalising	Unpredictable
Problem solving	Retaining	Converging	Diverging	Debating	Unpredictable

Table 2. Five Idea Generation Archetypes (Vandenbosh et al 2001 in Handzic & Chin 2003).

Leibnizian inquirers are seen primarily as the instrumentalists, placing a great deal of importance on what they already know. Lockean inquirers are known as the consensus builders, typically asking others to generate ideas and focusing on agreement. Kantians are viewed as searchers who combine ideas from diverse sources and unusual associations. Hegelians are known as debaters, arguing internally with themselves to develop ideas. Finally, Singerians are considered to be the most flexible inquirers, comfortable with, and employing, all systems of inquiry (Handzic & Chin, 2003).

Despite the current predominance of the Kantian approach to discovering knowledge, for effective idea generation all of these different approaches to learning and innovation need to be facilitated, especially given the challenges described in Section 4 that are likely to characterise the NCW environment. To achieve this, information and organisational frameworks must support and accommodate all these modes of thinking.

5.2 The Social Context and Human Values

It is impossible to understand human values devoid of the social and cultural context. Everyone is influenced by the communities they live in. Therefore, how the community forms a pattern of values which constitutes its culture, and how it orders/disorders the structures of relations between persons and groups, becomes a starting point for learning. In any organisation comprising a range of dynamic communities, its values, culture and modus operandi are shaped by a multitude of factors. Some of these factors are discussed in the sections below.

5.2.1 Power and Politics

Politics, in an organisational context, is increasingly well acknowledged as a significant issue in information systems theory and practice and therefore also, by implication, for NCW as an information technology enabled concept. For example, Checkland and Holwell (1998) say:

"... the introduction of IT will always have implications and consequences beyond the purely technical. There will always be political consequences of introducing IT. This is to use the word 'politics' to cover a set of processes which relate to the continual achievement of accommodations with respect to the disposition of power among people and/or groups of people."

NCW is clearly an information technology enabled concept and can therefore be expected to have political implications for the organisation, or organisations, in which it is introduced and operates. Indeed, in the first Gulf War of 1991 there were such political effects even though the NCW capabilities in that war were, by today's and certainly tomorrow's standards, basic at best. For example, during the aerial bombardment that preceded the land war there was extensive, although not complete, information about potential targets available to the coalition forces, and these were prioritised for attack by the commanders of the air war, who were (unsurprisingly) Air Force officers. These officers, arguably for organisational power and political reasons as much as any, preferentially chose targets that fitted their conception of the war and how it should be approached. Their ambition was to prove that air power, in its own right, could be used to win a war. Army and Marine nominated targets were therefore ignored, relatively speaking, in favour of more 'strategic' targets such as infrastructural and Iraqi high command related ones. This was not what the Army and Marine commanders wanted, and the result was that the Army officially complained in a situation report to the Pentagon. Eventually, the Marines, whose combat air forces had been committed to the air war under the Air Force commanders, withdrew them and brought them back under their own control (Gordon & Trainor, 1995). The availability of this potential target information and the way it was used evidently served to raise intra-organisational disagreement and reveal power and political issues that would almost certainly have been less significant, if not completely absent, had it not been available. So, the lesson for NCW most likely is that the technological capability to obtain and distribute more and better quality information than ever before is not necessarily, or even probably, going to result in improved understanding and closer and better cooperation in the organisation. Perhaps even the opposite effect could occur, under certain circumstances.

The expectation in much of the discussion of NCW is that it will automatically enable improved control, coordination and cooperation between different organisational units and force elements, but this expectation seems to be founded on a traditional or classical view of organisations and how they work. This view stems from the early work of authors such as Henri Fayol, Frederick Taylor and Max Weber (see, for example, Shafritz & Ott, 1987) and pictures an organisation as a unitary entity, rationally designed and run, with an explicit formal structure and a defined place and role within that structure for all members of it. However, it is now well recognised that their conceptualisation is highly simplistic and narrow, completely omitting aspects of individual and group behaviour that are of considerable importance to understanding actual organisational behaviour. For example, the traditional or classical theories of organisations have difficulty accounting for phenomena such as conflict and political activity and mechanistic organisations "have

great difficulty in adapting to changing circumstances" such as would, of course, be encountered by an NCW enabled military force (Morgan, 1986).

5.2.2 Cooperation and Collaboration

A common feature of complex military operations is the involvement of a range of multinational forces and, in addition, other government and humanitarian agencies. Each agency or force brings its own culture, philosophy, goals, practices and skills to the crisis, and the challenge becomes finding a way to synchronise everyone's efforts. It has been argued that

"Collaboration is essential to shared situational awareness because it allows widely dispersed people to use their battlespace awareness for mutual advantage. It also allows people to make, and make use of, expert contributions to analysis and decision -making. It involves a shift from sequential planning activities to an ongoing interaction between different levels, thus saving time and providing opportunities for ideas to move across boundaries. Network connectivity is important for providing the technical means that will assist collaboration, but the quality of our people will be more important" (Defence, 2003a).

The ongoing war on terrorism and war in Iraq have illustrated some great military successes in the realm of network centric warfare but also brought many shortcomings to light. Collaboration in NCW is often looked at in terms of collaborative tools. The problem is that the collaboration tools being used in different countries are not always interoperable, and that means the true vision of network centric warfare is not yet being realised. Technology is the enabler in the equation, and it must be easy to use and interoperable, or commanders cannot and will not rely on it.

However important the technology is for cooperation and collaboration in the network centric environment, information and networking alone are not substitutes for cooperation and collaboration based on common goals, common identity, mutual trust, doctrine that reflect these values, and sharing of information. In fact, as argued in Section 4, sharing of information lies at the core of NCW. Sharing has an organisational, a behavioural, and a technical component. While the technical component enables, the organisational and behavioural components generate value.

5.2.3 Trust

Effective and efficient exchange of information underpins the success of all military activities. Without such exchange, the collective action and cooperation necessary for the accomplishment of military goals, particularly in operational contexts, is impossible. However, effective information exchange in a warfighting context is often more difficult than it first appears. Factors can emerge which obstruct an individual's willingness to volunteer information or to provide it to others on request, particularly when the information of concern is highly sensitive and when the potential recipient is largely

unknown. A concern over how others might use valuable information often restricts one's readiness to part with it (Erickson, 1979).

A large amount of research has demonstrated that the extent to which an individual trusts another has a significant impact on their willingness to exchange valuable information with others (e.g. Fine and Holyfield, 1996). Despite this extensive empirical attention, however, consensus on a definition of trust has not been forthcoming (Barber, 1983; Kramer, 1999). For present purposes, trust can be defined as the subjective expectation of positive treatment under conditions of vulnerability (Mayer, Davis, & Schoorman, 1985). In other words, one trusts another to the extent that one believes they will act beneficially (or at least not detrimentally) if one choose to engage them in some form of cooperation and when cooperating involves some degree of risk (Gambetta, 1988). Thus, trust is especially relevant when there is uncertainty or ignorance as to the motives and actions of others. When these can be predicted with absolute certainty, trust is not required. When they cannot, as in most 'real world' circumstances, a degree of trust is necessary to make human action and interaction possible.

The idea that important military outcomes, like information exchange, are shaped by the presence or absence of trust is particularly salient when the characteristics of 'future warfighting' are examined. There is widespread consensus, for example, that the future activities of the ADF (and, indeed all 'modernised' defence organisations) will be characterised by greater levels of interdependence and cooperation between previously disparate individuals, groups, and organisations (Hinge, 1996). Moreover, it is widely believed that future warfighting will be conducted in contexts that are increasingly uncertain and unpredictable. The breakdown of the relative certainty associated with the bi-polarity of the Cold War has meant that the activities which military forces must now perform (e.g. peace-keeping and peace-enforcement) are more diffuse and less predictable in nature than ever before (Dorman et al., 1998). As a result, Australia's military personnel will have to be more willing to be vulnerable toward each other than ever before. Put simply, the need to trust others will be a fundamental and paramount dimension of the future warfighting context.

5.2.4 Teamwork

Teamwork is essential to the success of any organisation and it is more so in a network centric environment. Within this context, it is useful to understand the difference between the terms 'team' and 'teamwork', and to recognise that the concepts captured by both terms are prerequisites for productive collaborative work. 'Teamwork' means an individual is accountable, it means sharing information, and working better together. On the other hand, in a 'team' everybody holds themselves and each other accountable and performance is measured against collective output (Drucker, 1999). Teamwork is a skill, and the lack of it can be a barrier to effective performance.

Bowman & Pierce (2002) conducted research aimed to delineate and better understand the cultural barriers to teamwork. They identified several cultural barriers to teamwork,

cognitive and organisational. They found that culture influenced cognitive fundamentals of teamwork, such as communication, coordination, and decision-making. Culture also influenced the organisational barriers, through rules and procedures for training and personnel selection.

The implications of that research are that it is important to understand how the cultural and organisational dimensions affect teamwork in order to be able to develop training tools to help leaders and teams to overcome these possible barriers. It is easy to misinterpret the actions of another team member, based on an incomplete or incorrect understanding of that person's cognitive style. Also, learning that some individuals prefer more or less detail in a task, or that they prefer more or less group interaction, or are more or less willing to approach a higher-ranking officer, could be a simple and cost-effective way of improving team dynamics. Therefore, an understanding of simple psychological profiles of personal working preferences (like Myers Briggs or the Team Management Index) can be enlightening, productive and constructive in team building.

5.2.5 Social Cohesion and Common Identity

Based on the authors' previous studies into Social Learning, a common identity is one of the most important factors in developing social cohesion, as well as in enabling social learning. A shift in thinking from seeing ourselves as separate to seeing ourselves as connected to, and part of, an organisation or organisational sub-unit correlated with a strengthening of common identity. This common identity is influenced by the extent of cultural cohesion, shared goals and shared understanding and is characterised by loyalty and trust among members of the organisation (Main et al., 2003).

Since each person's cognitive domain is fully personal and private, the same situation and information may lead to different perceptions by different persons. Even the same words may have different meanings to different people. This is because the interpretation of information is based on education, past experiences, and so on, and therefore will always differ to some degree. However, insofar as different people belong to a common group or work in a similar context, they share, to some extent, a common identity that can reduce this discrepancy. This is an important issue in NCW because the core effort is to develop and distribute superior situational awareness, common understanding of the commander's intent, and common identity to synchronise operations and activities (Ahvenainen, 2003).

5.3 Summary

An effective and enduring learning and knowledge development climate is an essential element of the network centric environment. Such a climate requires a supportive organisational context for interaction and learning, one that paves the way for developing and maintaining professional mastery, via training, education and social learning. To achieve the full potential of such learning and knowledge development, individual variations in capabilities, learning styles, and idea generating behaviour must be

recognised, accepted, and allowed to flourish. Effectiveness in these areas can be improved through purposeful steps to:

- acknowledge and respect the different needs and capabilities of people with diverse styles and temperaments, and recognise that people will be enabled to different degrees by any 'one size fits all' technical environment,
- recognise that technical tools are more rigid in carrying out routines than the people who formerly carried out such tasks – and ensure automated machine based operations are also investigated and reviewed as well as human performance,
- create, make explicit and support rules, roles and patterns of authority and responsibility that are appropriate to the kinds of thinking and informal learning required by all people in complex and changing contexts,
- promote rapid mobilisation of shared knowledge and recognise that many people will need to actively share in the decision making,
- engage in reflection and review the strategic effectiveness of the evolving patterns of activity, communicate, debate, question, experiment and critically evaluate and modify provisional solutions (Crawford, 2003).

Trust is an underpinning factor in knowledge development and knowledge mobilisation and it manifests itself in an acceptance of mistakes as learning events. It is also an essential element of willingness to share information, and the sharing of information is the foundation of NCW.

Other crucial elements for learning and knowledge development are teamwork, cooperation and collaboration. For these elements to be successful, they must be based on common goals, social cohesion, common identity, mutual trust, and doctrine that reflect these values.

A military force in an NCW environment is an organisation that will certainly face uncertainty and dissension about choices. Organisational politics can occur whenever there is such uncertainty, disagreement, and different possible actions. It is, therefore, essential to consider and carefully analyse the implications NCW will have from an organisational power and politics point of view.

6. Organisational Models and Potential Transformation Paths

There are a number of organisational models in the literature that represent organisations at different structural and functional stages. These models list the primary characteristics of these stages and map the transformations between them. Three models that have synergies with the direction that the ADF is taking toward NCW are: the Cynefin Model, the Knowledge Warrior Construct, and the Carnegie Mellon People Capability Maturity Model. These models are briefly described in this section to facilitate discussion of their utility as transformation pathways for the human dimension of NCW.

6.1 The Cynefin Model⁴

Most organisational models are based on three assumptions: the assumption of order (that there is a direct relationship between cause and effect in human interactions) implying that there must be a right or ideal way of doing things; the assumption of rational choice (that people make rational choices and that they can therefore be managed by manipulation of pain/pleasure outcomes); and, the assumption of intentional capability (that the actions of collective identities e.g. competitors, or communities, or nation states are the result of intentional behaviour). Recognition that these assumptions are not universally true is now being reflected in decision-making at the policy formulation and operational levels; however, the common tools and techniques available to managers assume they are universally true. In many organisations, for example, formal command structures and informal trust networks support (while they simultaneously compete with) each other.

It is not always possible to understand human interaction in terms of cause and effect relationships because humans are not limited to one identity and behave differently in different contexts, depending on the role or position they fulfil at any given time. Additionally, humans are not limited to acting in accordance with predetermined rules and patterns. For these reasons, one should only attempt to simulate human interaction as a tool for exploring the possible and for generating ideas, with regard to managing people and knowledge, not as a tool for recommending a course of action (Kurtz & Snowden, 2003).

6.1.1 The Cynefin Framework

Human interactions are often determined by our personal and collective experiences, and are often expressed as stories. The Cynefin model was developed as a means of talking about the interaction that occurs under structured processes and uncertain conditions,

⁴ The name *Cynefin* is a Welsh word whose literal translation into English as *habitat* or *place* fails to do it justice. It should be understood as the place of multiple belongings, the sense that all people, individually and collectively, have many roots, cultural, religious, geographic, tribal etc.

within informal as well as formal communities. This framework for examining human interaction may be of utility, as the ADO makes the transition from a hierarchical system of operating to a network centric way of operating.

The Cynefin framework gives decision makers powerful new constructs they can use to make sense of a wide range of unspecified problems. It also helps people to break out of old ways of thinking and consider intractable problems in new ways. The framework is particularly useful in collective sensemaking, in that it is designed to allow shared understanding to emerge through the multiple discourses of decision making groups.

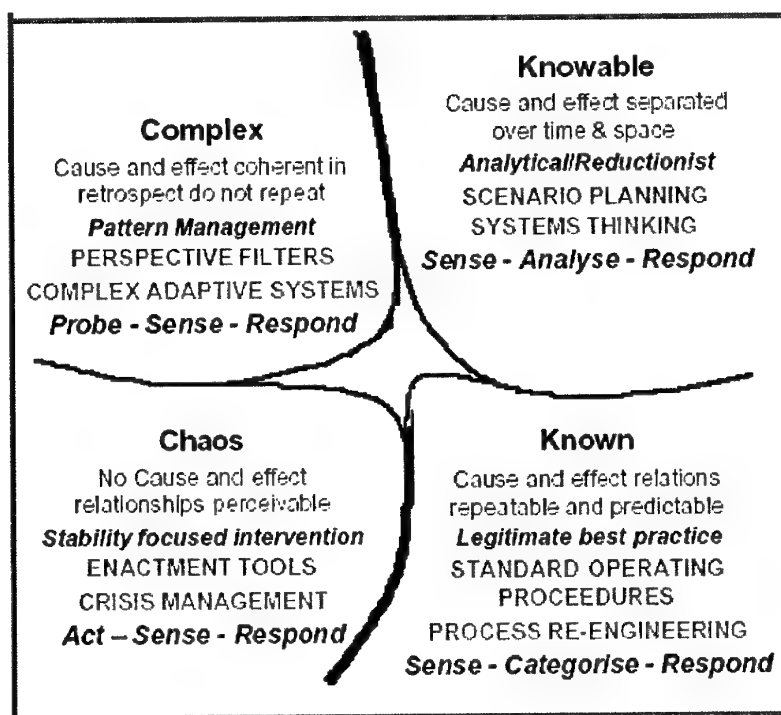


Figure 1. Domains of the Cynefin framework

As can be seen from Figure 1 above, the Cynefin framework has five domains, four of which are named, and a fifth central area, which is the domain of disorder. The right-hand domains are those of order, and the left-hand domains those of un-order. None of the domains is more desirable than any other; there are no implied value axes. Instead, the framework is used primarily to consider the *dynamics* of situations, decisions, perspectives, conflicts, and changes, and to recognise in which quadrant a given situation resides, in order to come to a consensus for decision making under uncertainty.

The Cynefin framework is phenomenological, in that its focus is on how people perceive and make sense of situations in order to make decisions. Perception and sensemaking are fundamentally different in Order than they are in Un-order. In the domain of Order, the

most important boundary for sense-making is between what we can use immediately (that is, what is known) and what we need to spend energy and time finding out (that is, what is knowable). In the domain of Un-order, the emphasis is not on distinctions of knowability but on distinctions of interactions - what we can pattern (that is, what is complex) and what we need to stabilise in order for patterns to emerge (that is, what is chaotic). More detailed descriptions of each quadrant are included in Appendix A.3.

6.1.1.1 Different ways of viewing the domains of the framework

Another way of viewing the domains of the framework is in terms of the types of connections that are most prevalent in each space, see Figure 2.

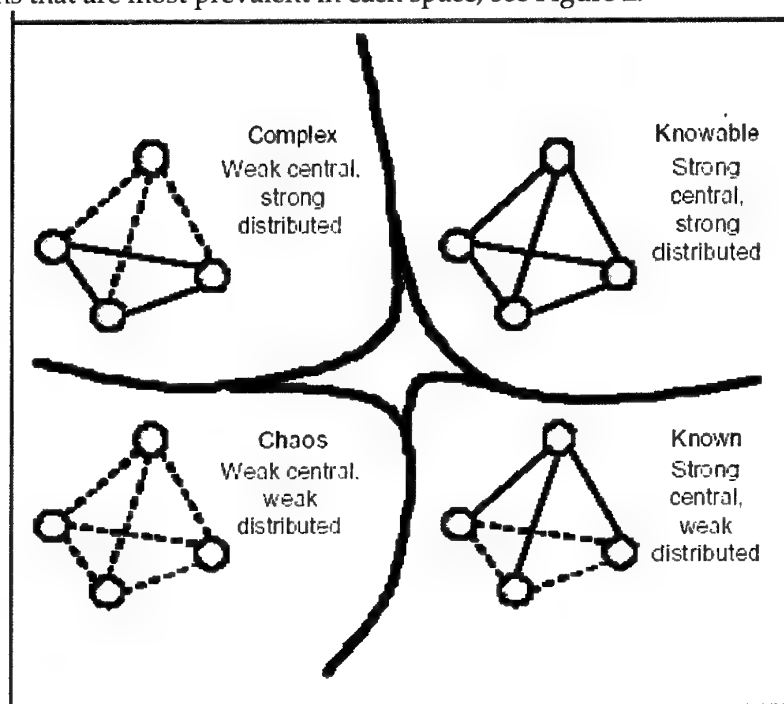


Figure 2. Cynefin: connections strength

In the domain of Order (right-hand side) connections between a central director and his or her constituents are strong, often in the form of structures that restrict behaviour in some way - via procedures, forms, expectations, etc. In the domain of Un-order (the left-hand side), connections between central director and constituents are weak, and attempts at control through structure often fail from lack of grasp or visibility. In the Complex and Knowable spaces (top two spaces), connections among constituents are strong, and stable group patterns can emerge and resist change through repeated interaction, as with mutual goals and experiences. In the Chaos and Known spaces (bottom two spaces), connections among constituents are weak, and emergent patterns do not form without intervention.

6.1.1.2 *Using the Cynefin framework*

Kurtz and Snowden (2003) suggest that a reasonable strategy in any of the spaces or domains is to capitalise on the stability afforded by strong connections without allowing them to harden so much that they destroy flexibility, and to capitalise on the freedom and renewal afforded by weak connections without allowing them to permanently remove useful patterns.

Groups might, for example, use the Cynefin framework to gain new insights on a contentious issue, plan interventions to move a situation from one domain to another, consider how they should approach or manage different formal and informal communities, or differentiate their strategies for knowledge retention based on multiple contexts of knowledge exchange.

When people use the Cynefin framework, the way they think about moving between domains is as important as the way they think about the domain they are in, because a move across boundaries requires a shift to a different model of understanding and interpretation as well as a different style of leadership. For a more detailed description please refer to Appendix A.3.

6.1.2 The Cynefin Model and NCW

The usefulness of the Cynefin Model lies in its ability to raise awareness of the dynamics of an organisation, which is essential in any deliberate attempt to effect change. The Cynefin framework is created anew each time it is used, with distinctions meaningful to that context. To some extent it does not even exist devoid of context, but is always used to enable sensemaking in a particular setting. It renders itself useful by whole divisions or small teams to gain understanding of their present situation and to show the pathways for change.

As stated earlier, operating in a network centric environment requires flatter organisational structures, relationships based on trust, and a suitable technological infrastructure. By using the Cynefin framework all factors and situations that may come into play when planning to adopt a network centric way of doing business can be considered. The process provides contextualisation of possible issues in relation to each other. The value of the contextualisation is that those participating often see patterns, sometimes for the first time, that overturn their entrained beliefs about the issue they are considering and about their purpose, goals, changing dynamics, and identity. The benefits of using this framework for NCW include:

- understanding 'pull' and 'push' forces,
- allowing for reflection and understanding of what the inhibitors and enablers are and how they interact,
- providing an intellectual vehicle for understanding of common intent which could drive doctrine changes,

- enabling the development of strategies to deal with untested elements of NCW, e.g. cases where weapons can be fired by other platforms and the psychological/emotional impact of this lack of control over the weapons on warriors, the impact of immediately knowing lethal outcomes, and seeing them as icons on a display monitor etc,
- understanding the 'chaotic space' which would facilitate faster OODA loops, i.e. quick responses to chaotic situations,
- allowing for 'rehearsal' of possible emergent scenarios,
- providing 'requisite variety' for training purposes, mission command and understanding of commander intent.

Furthermore, the framework can be used at a higher level to guide the transition of the human and organisational dimensions of NCW from the Known quadrant through to the Complex and Knowable. Use of this technique requires support from the IBM Cynefin Centre for Organisational Complexity, in Melbourne, which will train and then mentor DSTO or Defence personnel through the process. More information is available from www.ibm.com/services/cynefin.

6.2 Knowledge Warrior Constructs

Network centric organisations, in structure and in spirit, are designed to operate with a high degree of task interdependence in environments characterised by uncertainty. In such environments human judgment, intuition, and adaptability are of paramount importance. Technological solutions, however sophisticated, would serve only as enabling tools. Albert Einstein stated, "Computers are incredibly fast, accurate and stupid; humans are incredibly slow, inaccurate and brilliant; together they are powerful beyond imagination." The importance of the human element in network centric operations cannot be stressed enough and individuals need to be equipped with more than just technology. Knowledge and expertise needs to be mobilised across the nation to provide timely and relevant support to decision makers. Therefore, cross functional task forces, changing team composition designed to meet tasking and departmental needs, and flexible organisational structures will help to increase information processing capacity and integration of that information from within and outside the ADO. This is the central tenet of the Knowledge Warrior constructs.

Working in a network centric environment imposes far greater psychological demands on the individual than does a hierarchical structure. Networking means bridging vocabulary differences, learning new frames of reference, and listening to people who see the world differently. It also means going outside one's comfort zones and areas of expertise (Bush and Frohman, 1991). Some people are better suited than others to operate in such an environment. MacNulty (2002, 2003) and Tempestilli (2002) describe the characteristics of 'network centric' officers as those of 'knowledge warriors'⁵: they are very IT-oriented

The term *Knowledge Warrior* was coined by RADM Ken Staght and Dr Jeff Morrison to describe proactive users of information (MacNulty, 2003)⁵

'infoholics', they love information, have the ability to take a systems' view and to synthesise material into a coherent whole. Moreover, they know what information they want, when and in what format, when to drill down to more detail, and when to stand back and see the big picture. They are usually self confident, continually learning, and prefer to operate autonomously. This desire for autonomy and the willingness to innovate and take risks may pose a threat to those who are not like-minded.

One could argue whether "knowledge warriors" are born or bred; however, there are organisational processes that will facilitate the development of these characteristics. MacNulty (2003) makes a number of recommendations to transform future warriors into effective knowledge warriors, as follows:

- select, train and continually educate warriors to deal with complexity and distributed networked organisations,
- identify what best motivates people, e.g. incentives for innovation, more autonomy, rewards for performance and innovation,
- draw from a broad spectrum demographic base to ensure that the knowledge and expertise of more experienced warriors is fully utilised by younger, 'information age' warriors,
- provide infrastructure, both physical and virtual, to mobilise knowledge:
 - Access to information when and as needed,
 - Flexible training and education, e.g. distance learning, virtual tutors, tailored instruction and delivery,
 - More education than training.

Furthermore, MacNulty (2002) proposes a set of Human-centric transformational constructs to facilitate the transition to NCW. These are:

- Education and Training

	From	Transformed to
Style	Linear, sequential, serial	Non-linear, parallel, multi-media learning
Approach to Learning	Absorbing facts, materials	Learning how to learn
Access to Knowledge	Limited, based on need to know and course requirements	Requires Universal access to Human Knowledge
Approach to Subject Matter	Ad hoc mix of breadth and depth	Broad perspective or specific focus as needed
Timing of Education	Fragmented, as needed	Lifelong, continuous
Orientation	Group-oriented, lowest common denominator	Customised to individual intelligences, values, learning styles
How Education is Regarded	Necessary 'evil'	Education as fun
Approach to Teaching	Educator as transmitter	Educator as facilitator, guide

➤ Organisational Culture

	From	Transformed to
"Corporate" / Command Plans	Directive - "What" to do, and sometimes the "How" to do it	Guidelines - Clear Commander's Intent - freedom to do the "How"
Planning Process	Periodic long-term and short-term operational planning	Continuous, adaptive planning process
Information	Source of power - held closely	Shared freely - the more the better
Competition	Seen as advantageous	Seen as damaging
Attitude to Change	Resisted until inevitable - then too little too late	Embraced - seen as a way of life
Attitude to Risk	To be avoided	To be handled as a natural part of the job
Decision Making in Planning Cycle	Individual	Group Participation - bring together expertise
Resourcing Systems	Inflexible	Flexible

➤ Organisational "Management"

	From	Transformed to
Organisational Structure	Hierarchical pyramid	Adaptive, network organisations
Behaviour	Determined by role in organisation	Determined by emergent function and cross-functional relationships
Role of Manager / Leader	Expert, Director	Facilitator, Guide
Participative Management / Leadership	De-emphasised	Primary focus for planning and adaptive, emergent action
Power / influence	Related to roles and rank	Rests with those having control over uncertainty

➤ Organisational Development

	From	Transformed to
Organisational Concern	People look after selves and parent unit	Distributed organisation and other people look after each other
Networking	Important for individual achievement	Important for relationships, and group performance
Motivation	Getting ahead, ambition	Benefit to the group, the "customer"...
Interpersonal focus	Task oriented	Relationship oriented

Career and personal development	Dependent on authority	Greater mobility and boundary-crossing; greater responsibility for own development
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➤ Motivation and Rewards

	From	Transformed to
Reward Systems	Individual Based Penalises risk-taking – zero-defects mentality (in tactical sense). This does not include safety engineering.	Group Based Rewards innovation and appropriate risk-taking
Review Process	Hierarchical assessment and appraisal (often uncommunicated)	Self-review and assessment plus mutual appraisal of performance and potential
Amount of Rewards	Based on rank / position in organisation	Based on contribution to group results
Status	Very Important	Relatively unimportant
Valued Rewards	Money, Performance, Status, Medals	Quality of Life, Time, Education, Autonomy, Good Working Relationships

➤ System Design

	From	Transformed to
Systems	Man the Equipment	Equip the Man
Design	Human outside the system (<i>Human is Derivative</i>) For optimisation	Human-in-the-loop (<i>Human-Computer Warfighting Synergy</i>) For robustness and adaptability
Interface	External HCI	Augmented Cognition

Table 3. Human-centric transformational constructs to facilitate the transition to NCW

The key outcome of these transformational processes is to prepare fertile ground for a better way of doing business and enabling the human element within the NC environment. More detailed objectives of these transformation constructs are included in Appendix A.4

6.3 People Capability Maturity Model® (P-CMM®)

The P-CMM concept was originally conceived to attract, develop, motivate, organise, and retain the talent needed to continuously improve software development capability. However, the P-CMM can be, and has been, used by many different kinds of organisation as a guide for improving their people and workforce practices. There is considerable evidence that suggests that the predictability, effectiveness and control of processes improve as the organisation moves up the five prescribed levels of maturity (Bates, 2002). Since the P-CMM is a framework that helps organisations address their critical people issues, it is included in this section as a possible tool that could be used to guide the transformation of the ADF's people policies from their current form to policies shaped for an optimal network centric force of network centric warriors.

P-CMM claims to be based on the best current practices in human resources, knowledge management, and organisational development, and to be a guide for organisations improving their processes for managing and developing their workforces. The Model enables organisations to characterise the maturity of their workforce practices, establish a program of continuous workforce development, set priorities for improvement actions, integrate workforce development with process improvement, and establish a culture of excellence. Since its release in 1995, thousands of copies of the People CMM have been distributed, and it is used worldwide by organisations, small and large (CMSEI, 2002; Curtis, 2001). The P-CMM consists of five maturity levels that establish successive foundations for continuously improving individual competencies, developing effective teams, motivating improved performance, and shaping the workforce the organisation needs to accomplish its future plans, which in the ADO's case, is a network centric force.

Each maturity level is a well-defined evolutionary plateau that institutionalises new capabilities for developing the organisation's workforce. By following through the various levels of abstraction of the maturity framework, an organisation can avoid introducing workforce practices that its employees are unable or unprepared to implement effectively. The Model includes key individual, managerial and organisational practices that contribute to a maturing workforce capability. (CMSEI, 2002; Curtis, 2001). The five capability levels are shown in Table 4 below, at the highest level of abstraction, with the most desirable, optimising level of people capability shown as level 5.

Level	Focus	Organisation	Process
5 Optimising	Continuously improve and align personal, workgroup, and organisational capability. Dynamic optimisation and improvement across tasks	<ul style="list-style-type: none"> Continuous workforce innovation Organisational performance alignment Continuous capability improvement 	<ul style="list-style-type: none"> Continuously improving process Effective change management Zero defects Improvements are fed back to processes
4 Predictable	Empower and integrate workforce competencies and manage performance quantitatively. Definition, quantification, and control of sub-processes	<ul style="list-style-type: none"> Mentoring Organisational performance management Empowered workgroups 	<ul style="list-style-type: none"> Quality control Quantitative process management Processes are measured
3 Defined	Develop workforce competencies and workgroups, and align with strategy. Definition and quantification of processes	<ul style="list-style-type: none"> Participatory culture Workgroup development Competency-based practices Career development Competency development Workforce planning Competency analysis 	<ul style="list-style-type: none"> Standard, consistent stable, repeatable process Intergroup coordination Training program Organisation process definition Organisation process focus Processes are defined and institutionalised
2 Repeatable	Managers take responsibility for managing and developing their people. Project tracking and control	<ul style="list-style-type: none"> Compensation Training and development Performance management Work environment Communication and coordination Staffing Effectiveness depends on many individuals 	<ul style="list-style-type: none"> Documented Enforced Trained Measured Able to improve
1 Initial	Baselining	<ul style="list-style-type: none"> Ad hoc, chaotic Effectiveness depends on one or more individuals 	<ul style="list-style-type: none"> Workforce practices applied without analysis of impact

Table 4. : Five Capability Maturity Levels (Bates, 2002)

6.3.1 Applying the Model in a Military Context

Edgar Bates, of the Office of the Chief of Naval Operations (USA), used the Model as a framework for measuring Situational Awareness (SA) as part of the Human Element Group's Report: "FORCEnet, The Naval Component of the GIG - Enabling the Joint Warfighter through Network Centric Warfare" for the National Defense Industrial Association (NDIA), Strike, Land Attack and Air Defense (SLAAD) Division (Bates, 2002) (see Appendix A.5 for more details of this application). Bates concludes that "the major challenge to transformation in the US Department of Defense is not technological, but organisational. As rapid advances in information technology enable network centric warfare to move from concept to the battle-sphere, traditional metrics of "warhead on forehead" need to be updated. Performance improvements such as increased responsiveness and efficiency need to be measured in the context of SA and KM which are fundamental to guiding process improvements in the storing, organizing and processing of information" (Bates, 2002).

Although the example given by Bates is high-level, and therefore only indicative, it does suggest that a full P-CMM assessment could be useful in documenting, measuring and guiding the work force transformation to NCW structures.

More information is available at:

<http://www.sei.cmu.edu/products/publications/95.reports/95.mm.002.html>

7. Conclusion and Way Forward

In this document, the outcomes of a comprehensive, but not necessarily exhaustive, examination of the literature are presented as a representative overview of the salient human issues for the future Network Centric warrior. In this section, these issues are summarised in terms of the recurring themes, and the concerns and consequent challenges that have arisen because of them. While every one of these highlighted concerns could, and should, be followed up with more research in the future, this section also includes some specific suggestions for high priority further research.

7.1 Recurring Themes

Two issues became glaringly self evident as this document was being prepared: the first was that there is a lot of related work going on within the ADO, and external agencies, that could help progress this research and other research in NCW; and the second was that the same intertwined and multi-layered themes continue to appear no matter whether the focus of the research is organisations, individuals, groups, learning or the battlespace.

7.1.1 Related Research

While interest in NC organisations and NCW continues to grow, there is already a significant amount of work being done in directly, or peripherally, relevant areas that should be tapped into for research on the human dimension of NCW. While much of this work has already been mentioned in this report, other research has not, as it is focused at a much lower level of detail than is covered by this document. For instance:

- Michael Skinner, at the Air Operations Division (AOD), DSTO Fisherman's Bend is working on designing interfaces to take into account the human operator in an NCW context, in particular as it relates to Wedgetail. He is working on both visual and voice interfaces.
- Associate Professor Glenn Stewart, of the Queensland University of Technology, an Army reserve officer, has been researching the use of reserves for specialist IT positions in the Army. A discussion paper on this research is available in Appendix A.6.
- A collaboration project, C2 Warrior, involving the US Air Force Research Laboratories (AFRL), the UK and DSTO, is looking at enhancing understanding of cognitive demands and operational requirements of air battle managers, within the context of future warfare.
- Thea Clark, Terry Moon and Suzie Fewell, Defence Systems Analysis Division (DSAD), DSTO have been developing an Organisational Interoperability Maturity Model (OIM), which, in its next iteration, is to be applied to NCW.
- Robin Holcroft, AOD, DSTO and Bob Bolia, AFRL are working on Multi Layer displays as a way of improving data displays for Multi Object Tracking and for

air battle managers, respectively. Bob Bolia identifies the problem as there being "more information to display than there is display space to display it on"⁶.

- The Smart Internet Technology Cooperative Research Centre associated with the Royal Melbourne Institute of Technology is involved in user-centred design of information displays to minimise information overload and facilitate understanding of data.

While these projects only constitute a fraction of the related research identified while preparing this document, of more concern are the many projects that were not encountered, and which may be of interest to NCW research, or may even run in parallel to it.

It is therefore, strongly suggested that a Defgram be issued, ideally under the signature of Chief of Defence Forces (CDF), Chief Defence Scientist (CDS) and the Secretary, that all ADO personnel involved in NCW related research make their work known to a central point of contact (POC), or publish a brief description of it on a nominated website, to facilitate collaboration and to eliminate duplication or nugatory work. Furthermore, it is suggested that someone be tasked with identifying and publishing any external research that may be related to NCW and could be utilised by the ADO.

7.1.2 Dominant Recurrent Themes

There were a number of recurring themes that dominated this research. While it is sometimes difficult to separate one from the other, it is nevertheless useful to attempt to do so. These themes are:

- future warfare will be different. Not only is there likely to be NCW, but there will also be NC Peacekeeping and other Network Centric Military Operations other than War (NCMOOTW), and maybe even Network Centric Military Operations in Urban Terrain (NCMOUT),
- the future Force will frequently function in mixed operational units, jointly, with coalition forces, with reserves, and supported by industry and humanitarian agencies,
- the future battlespace will be information rich, high tempo, unpredictable, require effective information sharing and collaboration and will operate under commander's intent rather than detailed direction,
- trust will be a vital component of the battlespace and collaborative operations,
- the future warfighters will need to process, absorb, share and then make decisions using vast amounts of information presented to them in a variety of formats,
- operating under commanders' intent will be of paramount importance. This will profoundly impact on organisational culture, structure and the skills base required,

⁶ Bob Bolia "A visual depth display for air battle managers: Effects of depth and transparency on performance and workload" Presentation given at Warfighters Review, DSTO, Fisherman's Bend, 8 December 2003.

- new skills and competencies will be required in the NCW context. These are listed in the next section, and
- new recruitment, education, training, retention and Human Resource Management (HRM) policies will be required. Some of these are listed in the next section.

7.2 Concerns, Challenges and Considerations

The primary concerns and challenges identified in the process of compiling this literature review are listed below. They are offered not necessarily as recommendations, at this stage, but more as an aggregation of issues for consideration, reflection and discussion. While some concerns are merely highlighted, others include suggested follow-up work that the ADO may wish to consider. The issues the researchers determined to be of highest priority are marked with an asterisk and italicised. These concerns and challenges are grouped under a number of headings which, to a certain extent, reflect the recurring themes embedded in this document.

7.2.1 Cultural Shifts

Operating within commander's intent requires a paradigm shift in tradition and culture, both for senior officers and junior commanders. It requires devolvment of the locus of decision-making, autonomy based on trust, empowerment and confidence in the decision-makers, and the requisite intelligence and skills for continual self-synchronisation.

- * *Research is urgently required to determine the most effective way to implement this cultural change in a holistic manner.*

That cultural shift must foster leadership, education, process, organisation, values and attitudes that encourage and reward those who embrace innovative risks, and foster an environment conducive to continuous learning. Such an environment requires a supportive organisational context for interaction and learning, one that paves the way for developing and maintaining professional mastery, via training, education and social learning. Further research needs to be conducted on transforming the ADO to a learning organisation.

Trust underpins knowledge development and knowledge mobilisation. It is also an essential element in devolving command and in willingness to share information, which lies at the core of NCW.

- * *Further research must also be directed to the antecedents of trust in an NCW context, and to those factors likely to impact on its ability to be maintained.*

Other crucial elements for learning and knowledge development are teamwork, cooperation and collaboration. For these elements to be successful, they must be based on common goals, social cohesion, common identity, mutual trust, and doctrine that reflects these values. Collaboration must be viewed in terms of human-to-human interaction, rather than just as being technology based connectivity.

7.2.2 Organisational and Structural Issues

The old traditional, centralised and hierarchical structures, that were suitable for relatively stable and predictable conditions, may have to be replaced by flexible and 'flatter' structures to facilitate devolved command.

- * *Research into what would be the most suitable structures must be conducted and tested through simulation and experimentation.*

Ideally, training should be an obligatory part of the capability TRF (Technical Register Framework) not just a desirable part of the Capability Options Documents (CODs), as it is at present.

7.2.2.1 Workforce requirements

Recruitment policies should be developed to draw expertise from a range of the demographic and cultural spectra including older age groups, women, non-Anglo Australians, and part-timers.

- * *Research would be needed to ascertain how this mix would impact on the ADF and if it was found to be an effective strategy, market research needs to be conducted on how to attract these people to military careers.*

Positions may need to be created for military personnel who would otherwise retire to take advantage of their considerable experience and military knowledge. These positions could be in military educational institutions or in mentoring roles.

Research assessing the plausibility of this change should be conducted.

7.2.3 Required skills, competencies and characteristics

Since the Network Centric Warrior will be required to deal with war, peace, terrorism and any number of yet unknown situations, it would be desirable to have a mix of the following skills and characteristics:

- versatility, adaptability, flexibility, confidence, independence, initiative, intercultural competence,
- system thinking,
- relationship management,
- cognitive skills
- emotional intelligence,
- ability to cope with uncertainty and ambiguity, and
- the ability to innovate and to improvise.

- * *Research needs to be conducted to determine if these qualities are born or bred and whether acquiring them should be a part of recruitment, and/or education and training policies.*

7.2.4 Integrated Teaming

If the ADF is to work effectively in integrated teams it has to go beyond integrated infrastructure and encompass the social and psychological bases of interpersonal and inter-group cooperation, based on openness, information sharing and mutual respect. This basis lies in a shared sense of trust, identity and commitment amongst personnel, and manifests as effective information exchange and a willingness to engage in cooperative behaviours.

- * *Research has to be directed toward this level of integration, and further attention must be directed to the extent to which personnel can be educated into thinking and behaving cooperatively and collaboratively within and between mixed teams.*

Personnel should be made aware of the individual differences in habits of communicating and decision-making, including their own, and develop skills in recognising, communicating with and accommodating people of various styles and temperaments.

Appropriate methodologies for instilling this information should be investigated.

Joint exercises, joint assessment and even joint years in military institutions, starting from recruit schools, should be considered to enculture jointery and working in integrated teams.

- * *The degree of change necessary and the plausibility of such change should be researched and appropriate recommendations made.*

7.2.5 HRM policies

While job rotation and the posting cycle is a very useful career development strategy, serious consideration needs to be given to changing the duration of the posting cycles. Best practice dictates that executive stability is an essential factor in developing and sustaining organisational change.

The impact on ADF career management needs to be carefully investigated before such policy is put in place.

Leadership and support should be given for cooperative behaviours including mentoring, mediating, critical debate, negotiating, explaining, coordinating and above all communicating effectively. Current policies do not recognise the impact of social experience on individual behaviour and emerging beliefs and capabilities.

Cultivate and reward desired behaviours like teamwork, cross service work and information sharing.

7.2.6 Education and training requirements

Education and training in languages, people skills, political science, and social history should become as important as technical skills.

An investigation of the best means of implementing these curriculum changes should be conducted.

Ideally, training should become centralised by competencies, rather than by Services.

* *Structural, organisational and pedagogical effects of such a change should be researched as a matter of urgency.*

To cope with the information rich environment of NCW, the following competencies should be included in training programs:

- defining problems and collectively refining the objective of a shared activity,
- interpreting and validating available information and providing feedback and advice to other members of the group,
- determining an appropriate balance between the information available and the information essential to have before making a decision,
- choosing, debating and designing a shared overall strategy.

Appropriate training encompassing these competencies should be investigated.

As well as training for technical expertise, consideration should be given to training specialist information brokers - people who are trained specifically to scan incoming information for anything that might possibly be unusual, interesting or important and pass it on to others for consideration, analysis and decision.

The value of such a role in a NCW environment requires further investigation and if found beneficial, appropriate educational curricula should be developed.

7.2.7 User Friendly technology

The way information is presented has an important impact on how it is received and the effects it has. Individual differences in human thinking, communication, and decision-making should be considered when deploying technologies including group decision-making systems, and voice and visual information interfaces.

Supporting technologies, information interfaces and human-machine interfaces should be investigated to ensure they have accommodated the requisite range of human workplace preferences.

7.3 Future Directions

Any number of the issues identified in the previous section could and should be researched further to facilitate their implementation. As mentioned earlier, the high priority issues are asterisked. Future directions for this task will depend on the issues selected for further investigation, the level of abstraction possible, and the transformation pathways favoured by the ADF.

Perhaps the most useful input to the ADF Network Centric Warfare Roadmap would be via the target states table that appears in Annex B to the ADF NCW Roadmap, such that the selected issues can be addressed for the 2010, 2015 and 2020 timeframe (as in the

example table below). It may also be useful to include a target state for 2005 so that any necessary, immediate changes can be identified. The completion of this table can be guided by one or more of the transformation models discussed in Section 6.

	2010 TARGET STATE	2015 TARGET STATE	2020 TARGET STATE
Training via competencies rather than services	Essential competencies distributed through existing military educational institutions. Trainees move between institutions depending on the required competency.	Decisions made regarding permanent location for a full range of required competencies. Curricular in process to be refined and finalised.	All military educational institutions are competency rather than service based.
Trust building			
Change of organisational structures			
Changes in recruitment pool			
HRM changes			
Intergrated team development			

Table 5: Sample Human Dimension Target States

While the suggested issues that warrant further investigation are numerous and complex, there are some that need to be tackled as a matter of urgency. Based on this literature review, trust is one of the most important factors that underpins all of the organisational processes and, therefore, the authors of this report feel it needs to be given the utmost priority.

There are already pockets within the ADF operating very close to a network centric manner e.g. Australia's SAS contingent that participated in the latest Iraq conflict. It would be useful to study such a unit to determine best practice, what processes and procedures make them effective and to set a benchmark for others who follow the network centric path. Such a study would very likely shed further light on the role trust plays in team integration and effectiveness.

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9. Appendices

A.1. Appendix: ADF Core Qualities

The Australian Defence Force aims to cultivate and display certain core qualities in its personnel. And while these qualities may exist in other national armed forces, it is the way the Australian Defence Force fosters these through training and experience that has shaped the Australian Defence Force's *esprit de corps* and enabled it to develop its distinctive approach to warfare. These qualities, which are vital in combat situations, are:

- **Professionalism.** To achieve effectiveness and efficiency in military operations, there is no substitute for professional skill and attitude. Professionalism is the level of competence displayed by individuals, combat teams, headquarters, formations and units. Professionalism is about having high levels of technical skill and applying that skill with discipline, good judgment and adherence to ethical standards. This professionalism is developed in the Australian Defence Force through careful selection, thorough military training, ongoing education and experience.
- **Trustworthiness.** Operational success, morale and group cohesion all depend on trust. All Australian Defence Force members need to have this vital attribute given the life-threatening situations in which Australian Defence Force members may be placed during military operations. Australian Defence Force members must act with integrity, regardless of the personal cost, and gain the trust of their fellow Australian Defence Force members. Further, in peacetime we help to build this sense of trust by nurturing and caring for our people through placing a strong emphasis on safety and the elimination of unnecessary risk from our training activities, as well as ensuring that their families are properly looked after, particularly when they are not there to do this themselves.
- **Morality and legitimacy of action.** Combat operations inevitably involve death and destruction. Nevertheless, all Australian Defence Force members need to adhere to the Law of Armed Conflict and the moral principles that underlie them, so that military operations are conducted in ways that ensure the Australian Defence Force retains its legitimacy as a fighting force.
- **Teamwork and initiative.** Although the Australian Defence Force emphasises the importance of individual initiative, it does so in the context of the effect this has on enhancing teamwork. Only through good teamwork can the potential contribution of each individual member be maximised.
- **Courage and compassion.** The Australian Defence Force seeks to ensure that its members balance a strong fighting spirit with a spirit of compassion – particularly

towards non-combatants caught up in a conflict. Also, Australian Defence Force leaders at all levels have a duty of care to those under their command.

- **Fairness and respect for the individual.** The Australian Defence Force balances the need for a hierarchical structure for reasons of operational necessity and effectiveness with the recognition that all members of the Australian Defence Force are of equal worth as human beings and are entitled to 'a fair go'.
- **Carefully directed effort.** While the Australian Defence Force seeks to achieve militarily decisive outcomes, it also seeks to do this in ways that avoid needless loss of life or property. Australian Defence Force commanders and members therefore need to apply armed force with discrimination so as to achieve decisive military outcomes with as little collateral damage and wastage of resources as possible.

From:

Australian Defence Force (ADF). (2002b). *The Australian Approach to Warfare*. Canberra, ACT, Australian Department of Defence.

A.2. Appendix: Emotional Intelligence

Emotional Intelligence (EI) The Benefits?

What is Emotional Intelligence?

"Emotional Intelligence" refers to the capacity for recognising our own feelings and those of others, for motivating ourselves, and for managing emotions well in ourselves and in our relationships. It describes abilities different from, but complementary to, academic intelligence - the purely cognitive capacities measured by IQ.

'Motive and emotion share the same Latin root *motere*, "to move". Emotions are, literally what move us to pursue our goals; they fuel our motivations, and our motives in turn drive our perceptions and our actions. Great work starts with great feeling.'

Signs of Emotional Intelligence

Someone using Emotional Intelligence would have 'grounded intuitions and a passion for making an impact'. They are 'bold but grounded'. They have the 'capacity to fold into the decision-making process an intuitive sense of what is right and wrong' - 'an intuitive decision is nothing but subconscious logical analysis'.

Superior performers seek out feedback - 'they *want* to hear how others perceive them'. They are self-aware and want to improve, so they need to know what others think. They also provide feedback (*at the time of the event*), mentor and coach.

'The emotional foundation of the innovator is taking pleasure in originality...applying new ideas to achieve results. People who have this knack quickly identify key issues and simplify problems that seem overwhelmingly complex. Most important, they can find original connections and patterns that others overlook.'

Successful exponents of Emotional Intelligence **prepare** (immersing themselves in the problem and information), **incubate** (the information and possibilities), **illuminate solutions** (the "aha!" moment), and **take action** (requiring dogged persistence despite objections, setbacks and failures along the way).

Outstanding performers have a drive to achieve, commitment to the organisation's vision and goals and initiative and optimism. They have 'the ability to be flexible, to take in new, even painful information without tuning out in self-protection, and to respond nimbly'.

Optimism and hope are signs of Emotional Intelligence, because of the positive effect they have on the drive and enthusiasm of those around you. Expecting the best from

people can be a self-fulfilling prophecy.

Star performers:

- see diversity as an opportunity, creating an environment where diverse people can thrive, recognising that 'diverse people bring different, important and relevant knowledge and perspectives about how to actually *do work*',
- know that 'an accurate understanding of the formal organisational structure is not enough - what's needed is a keen sense of the informal structure and the unspoken power centres',
- 'involve people in at least some of the steps, [so that they] become missionaries for you',
- create 'an atmosphere of openness',
- 'spot potential conflict early' and help work it out openly,
- realise that 'building relationships [creates a] reservoir of trust' for the future,
- understand that 'about 20 per cent of a group are ready to put in the work to change at any given point', so helping the other 80 per cent to get ready can be an early and important task, and
- know that grand goals are important, but that people need to be 'buoyed by frequent small successes [to] stay motivated'.

Signs of a Lack of Emotional Intelligence

Where 'corporate inertia takes over instead, with top management failing to read the signs of the coming sea change - or fearing to act on the implications - even as the rules of the game are mutating.'

When employees feel 'resentment whether due to unequal pay or workloads, and so lose enthusiasm for the organisation's mission'.

When people are the cynics and no-sayers - who know that proposed change will not work because everything has been tried and failed before.

When people micro-manage - taking control over small details best left to subordinates, and lacking a basic awareness of how their actions affect other people.

When there is 'work overload...too little time and support'.

When people are accountable for work but have no real responsibility or control.

When a person's 'job is at odds with their values'.

When 'fear of being wrong [leads] people to withhold information'

IQ and Emotional Intelligence

'Given how much emphasis schools and admission tests put on it, IQ alone explains surprisingly little of achievement at work or in life. When IQ test scores are correlated with how well people perform in their careers, the highest estimate of how much difference IQ accounts for is about 25%. A careful analysis, though, suggests a more accurate figure may be no more than 10%, and perhaps as low as 4%.

This means that IQ alone at best leaves 75% of job success unexplained, and at worst 96% - in other words, it does not determine who succeeds and who fails. For example a study of Harvard graduates in the fields of law, medicine, teaching and business found that scores on entrance exams - a surrogate for IQ - had zero or negative correlation with their eventual career success'.

'...Emotional Intelligence, more than IQ or expertise, determines who excels at a job - any job - for outstanding leadership, it counts for almost everything'.

From a number of detailed studies the following emerged:

'...67% - two out of three - of the abilities deemed essential for effective performance were emotional competencies. Compared to IQ and expertise, emotional competence mattered twice as much. This held true across all categories of jobs and in all kinds of organisations.'

Technical or Emotional Competence

Having enough intellectual ability and technical know-how to do our jobs is now a given. Personal qualities such as initiative and empathy, adaptability and persuasiveness are what now separate star performers from average ones.

'When it comes to technical skill and the core competencies that make a company competitive, the ability to outperform others depends on the relationships of the people involved.'

'To be sure, many people have got to the top despite flaws in Emotional Intelligence; that's long been a reality of organisational life. But as work becomes more complex and collaborative, companies where people work together best have a competitive edge'.

From a landmark study of top executives, the two most common traits of those who failed were:

- 'rigidity: They were unable to adapt their style to changes in the organisational culture, or they were unable to take in or respond to feedback about traits they needed to change or improve. They couldn't listen or learn.

- *poor relationships*: The single most frequently mentioned factor: being too harshly critical, insensitive, or demanding, so that they alienated those they worked with'.

Benefits of Emotional Intelligence

'...The more support employees feel from their organisation, the more trust, attachment, and loyalty they will feel, and the better organisational citizens they will be. Organisational commitment grows from emotional bonding.'

Expecting the best from people can be a self-fulfilling prophecy...let others take the lead in setting their own goals, rather than dictating the terms and manner of their development...point to problems without offering a solution; this implies that they can find the solution themselves'.

'One of the virtues of building relationships is the reservoir of goodwill and trust that arises. Highly effective managers are adept at cultivating such relationships, whereas less effective managers generally fail to do so'.

'...Virtually everyone who has a superior is part of at least one vertical 'couple'; every boss forms such a bond with each subordinate. Such vertical couples are a basic unit of organisational life, something akin to human molecules that interact to form the latticework of relationship that is the organisation...If emotional intelligence needs to enter an organisation anywhere, it is at this most basic level. Building collaborative and fruitful relationships begins with the couples we are a part of at work.'

Improving Emotional Intelligence/Personal Responsibility

'Simply being high in Emotional Intelligence does not guarantee a person will have learned the emotional competencies that matter for work; it means only that they have excellent potential to learn them'.

'There is a crucial difference between *declarative* knowledge (knowing a concept and its technical details) and *procedural* knowledge (being able to put those concepts and details into action). Knowing does not equal doing....'

'Reaching the point where a new habit replaces the old takes extensive practice... we need to work both at *unlearning* the old, automatic habit and at *replacing* it with the new, improved one'.

'The good news is that Emotional Intelligence can be learned'. 'Unlike IQ...Emotional Intelligence seems to be largely learned and it continues to develop as we learn from our experiences' – but sustained growth requires effort. 'Individually, we can add these skills to our tool kit for survival at a time when 'job stability' seems like a quaint oxymoron.'

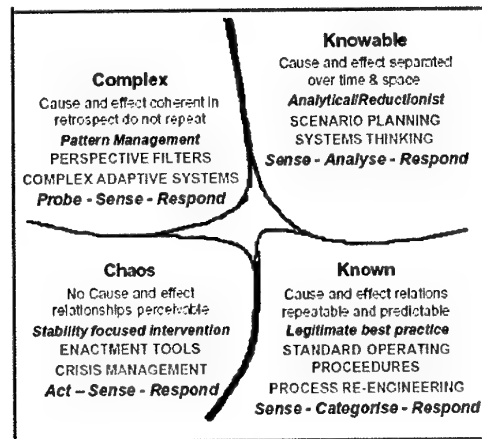
'Both work and learning are social...Key to successful performance with knowledge workers - with any workers - is instilling enthusiasm and commitment, two qualities that organisations can learn but not compel...That's where Emotional Intelligence comes into play.'

'The emotional economy is the sum total of the exchanges of feeling among us. In subtle (or not so subtle) ways, we all make each other feel a bit better (or a lot worse) as part of any contact we have; every encounter can be weighted along a scale from emotionally toxic to nourishing.'

From :

Daniel Goleman, (1998b) *Working with Emotional Intelligence*, Bloomsbury: London.

A.3. Appendix: The Cynefin Model explained



In the **Known** quadrant (which lies within the Ordered domain), the decision-making model is to sense incoming data, categorise that data and then respond in accordance with predetermined practice. Cause and effect relationships are known, and therefore structured techniques are not only possible and desirable, but mandatory.

In the **Knowable** quadrant (also within the Ordered domain), the decision-making model is to sense incoming data, analyse that data and then respond in accordance with expert advice or interpretation of that analysis. Here stable cause and effect relationships also exist, but may not be fully known. Therefore, structured techniques are desirable, but assumptions must be open to examination and challenge.

In the **Complex** quadrant (within the Un-Ordered domain), the decision model is to create probes to make the patterns or potential patterns more visible before action is taken. These patterns are then sensed and responded to by stabilising those patterns that are desirable and destabilising those that are not. In the Complex space, there are cause and effect relationships between the agents, but they cannot be categorised or analysed, and therefore they cannot be predicted, only perceived. Therefore, the methods, tools and techniques of the Known and Knowable do not work; instead, what is needed are techniques which promote multiple perspectives and thus stimulate emergent order.

In the **Chaos** quadrant (also in the Un-Ordered domain), unlike the other three quadrants, there are no visible relationships between cause and effect. Since there is no system to be worked, the decision model is to act, quickly and decisively (to reduce the turbulence), and then to sense immediately the reaction to that intervention and respond accordingly. There are numerous options for acting: an authoritarian intervention can be made to control the space and make it knowable or known; or there may be a need to focus on multiple interventions to create new patterns and thereby move the situation into the

complex space; Chaos is also a space that can be entered consciously to open up new possibilities and to create the conditions for innovation.

Decision-makers often disagree on the more subtle differences in the central space which is referred to as **Disorder**, interpreting it on the basis of their preference for action. For instance, those most comfortable with stable order seek to create or enforce rules; experts seek to conduct research and accumulate data; politicians seek to increase the number and range of their contacts; and the dictators take the opportunity of a crisis situation to seek absolute control.

The information on the Cynefin Model is largely derived from:
Kurtz, Cynthia F; and Snowden, David J. (2003) "The New Dynamics of Strategy: sense-making in a complex-complicated world", *IBM Systems Journal*: Fall 2003.

More information is available on:
www.ibm.com/services/cynefin
and
<http://www-1.ibm.com/services/cynefin/>

A.4. Appendix: Knowledge Warrior Constructs

Transformed objectives:

- Education and Training:
 - Warriors with evolved warfighting skills and cognitive resources to deal with complex interactions, novel circumstances and distributed collaboration
 - Universal access to needed (universal) knowledge
 - Individuals comfortable with using a wide range of technologies, weapons, systems
 - Training and education system emphasising capabilities to operate effectively in dynamic, ambiguous and uncertain environments, and as part of a highly adaptive, networked, organisational system
 - Speed and adaptiveness of action, coupled with cohesion of effort and appropriate contribution to effects
- Organisational Culture:
 - Leader emergence based on ability to respond to emergent circumstances
 - Dynamic leadership (and other role) assignment in informal organisations
 - Pervasive awareness and access to globally available information resources in order to form appropriate collaborative, knowledge-based teams
 - Innovation, adaptiveness, collaboration, emergence, and complex networking are the key cultural underpinnings
 - New risk definitions NCW context, new belief systems, values and behavioral norms for network centric organisations and operations
 - New personnel incentives and management structures consonant with new culture, knowledge, skills and abilities
- Organisational "Management":
 - Clear organisational structures in an environment that also allows emergent, informal, ad hoc organisational structures to form and function collaboratively in face of novel circumstances
 - Access to globally distributed niche resources, experts, knowledge bases, and information processing tools
 - Shared application of variety of non-organic, distributed sensor and weapon systems
 - Integrated technologies and processes to support context discernment and management
 - Leaders and managers operate more at the "boundary" – reconciling external and internal resources and forces – not only within the confines of their own organisation

- Real power and influence rests with those having control over uncertainty, not solely with role and rank
- The network organisation is what needs to be managed – the linear processes should not be prescribed or managed
- Organisational Development:
 - Values of the organisation reflect reliance on people, knowledge, and information.
 - People are expected (and rewarded) to help each other
 - Absolute trust that each will discharge accountability and authority as vested in the new, adaptive, distributed approach
 - Duty is absolutely clear throughout the organisation
 - Recognition that shared cognition of what is tactically and operationally valuable creates collaborative trust and cohesion which, in turn, lead to:
 - Greater appreciation of emergent and unfamiliar contexts and situations
 - More coherent and better aligned, agile and adaptive shared actions and effects
 - Equal emphasis on people and technology – a synergistic relationship.
 - Joint and interagency focus as means to access needed capabilities.
 - Organisation's vision, management/leadership style, communications reflect values.
- Motivation and Rewards:
 - Motivation and reward systems offer people incentives for innovation, generating, sharing and utilising knowledge.
 - Appropriate risk taking is rewarded.
 - Failures are accepted as learning opportunities.
 - Focus on synergy de-emphasises distinctions between humans and technology.
 - Complexity and ambiguity are naturally assimilated working conditions.

Products are designed to work for the operator – not the operator for the computer.

A.5. Appendix: People Capability Maturity Model[®] (P-CMM[®]) applied to Situation Awareness

From: Bates, Edgar (2002) "Human Element Group's Report : "FORCEnet, The Naval Component of the GIG Enabling the Joint Warfighter through Network Centric Warfare" prepared for the National Defence Industrial Association (NDIA), Strike, Land Attack and Air Defence (SLAAD) Division

The core of a P-CMM Assessment is an on-site investigation conducted by an assessment team. The assessment is based on the P-CMM diagnostic tools designed to identify strengths and weaknesses in workforce practices against a community standard. The assessment can be used to set priorities for improvement needs so that the organisation can concentrate its attention and resources on a small, but critical, number of improvement actions. The assessment normally consists of the following four phases of tasks and activities:

- Preparing phase - preparing for the assessment (2-3 months)
- Surveying phase - conducting the workforce practices survey (6-8 weeks)
- Assessing phase - conducting the on-site assessment (1 week)
- Reporting phase - reporting the assessment results (various)

However, by selecting key process areas to be examined, a P-CMM-Based Assessment can be tailored to the specific objectives and scope of a particular assessment, as shown in the table below:

Five Capability Maturity Levels of Situational Awareness

Level	SA Focus	SA Process
5 Trans- formational	Agent based communication; establishing a process for adapting processes to support operational contingencies; establishing knowledge delivery mechanisms to provide knowledge to strategic partners; process optimisation	<ul style="list-style-type: none"> • Evaluation of performance and effectiveness on a continuous basis • Identifying adjustments and potential improvement to the fusion process • Determining source specific data requirements for processing • Recommending allocation and direction of resources in support of the mission • Understanding mission, opportunities and risks, adversary's capabilities and limitations, analysis of possible outcomes, and <u>adversary's intent</u>

Level	SA Focus	SA Process
4 Predictable	<p>Concepts embedded in data translated into a common ontology; data mining for patterns and relationships; presentation of knowledge based upon the user's</p> <p>learning profile; network of multiple portals enabling the real-time aggregation of disparate knowledge</p>	<ul style="list-style-type: none"> Estimating capabilities, i.e. number and location Predicting enemy intent based on actions, communications and enemy doctrine Identifying threat opportunities - ID of potential opportunities for enemy threat Assessment from multi-perspectives Analysing predictions of offensive/defensive results of hypothesised engagements Understanding mission, opportunities and risks, adversary's capabilities and limitations, <u>analysis of possible outcomes</u>
3 Defined	Data is aggregated in a central data base; data from multiple operational systems can be extracted on demand; richer artefacts of the process are stored and organised; data presentation includes summaries and analysis; collaborative tools which capture the timeliness, breadth and depth of subject matter experts	<ul style="list-style-type: none"> Estimating relationships among aggregated objects including events/activities Interpreting within context weather, terrain and other environmental considerations Assessment from a multi-perspective (i.e. Blue, Red & White viewpoints) Understanding mission, opportunities and risks, <u>adversary's capabilities and limitations</u>
2 Repeatable	Data repository mechanism provided to capture individual input and retrieve data; forum provided for distributed collaboration	<ul style="list-style-type: none"> Focus on individual objects Associating sensor outputs w/specific known objects or initiate new objects Using sensor data to refine the best estimates of current positions for each hypothesised object. Understanding mission, <u>opportunities and risks</u>
1 Initial	Limited collaboration, data fusion or correlation	<ul style="list-style-type: none"> Aligning data with respect to time/space Relating newly received observations to existing track Comprehending basic classification of emitters, platforms, etc. Understanding mission

Level 1: The Initial Level

At the initial level, the organisation typically does not provide a stable environment. During a crisis, planned procedures are abandoned. Success depends entirely on having an exceptional leader. Even strong tactics, techniques and procedures (TTP) cannot overcome the instability created by a dysfunctional organisation. Capabilities of Level 1 organisations are typically unpredictable because the process is ad hoc and occasionally chaotic. Few processes are defined. Performance depends on the capabilities of individuals and varies with their innate skills, knowledge, and motivations, which mean that performance can be predicted only by individual rather than organisational capability. This is the lowest level of data fusion inasmuch as it doesn't exist. Without any data fusion, SA is based on the manual correlation and/or aggregation of linked track data. This would also correspond to the lowest level of individual SA, which is the fundamental perception of important information ...

Level 2: The Repeatable Level

Policies and procedures are established and institutionalised. Planning and managing new tasks are based on experience with similar projects, which allow organisations to repeat successful practices developed on earlier tasks. An effective organisation's process is practiced, documented, enforced, trained, measured, and able to improve. Problems in meeting goals and performance standards are identified when they arise. Level 2 organisations can be characterised as disciplined because planning and execution of the mission is stable and earlier successes can be repeated. The key process areas at Level 2 focus on instilling basic discipline into workforce activities. From the standpoint of data fusion the focus is on individual objects. SA as a construct is still fundamentally about basic perceptions of important information.

Level 3: The Defined Level

The Level 3 organisation exploits effective policies and procedures that are well documented and integrated into a coherent whole. There is a dedicated component organisation that has been institutionalised and is responsible for the organisation's process activities, i.e. quality control/analysis. An organisation-wide training program is implemented to ensure that the staff and managers have the knowledge and skills required to fulfil their assigned roles. A well-defined process can be characterised as including readiness criteria, inputs, standards, and procedures for performing the work, verification mechanisms (such as peer reviews), outputs, and completion criteria. Because the process is well defined, management has good insight into the level of performance that is based on a common, organisation-wide understanding of activities, roles, and responsibilities. The key process areas at Level 3 are knowledge and skills analysis, workforce planning, competency development, career development, competency-based practices, and participatory culture. Data fusion is devoted to organising the hypothesised objects into a big picture of what is happening. The big picture is described in terms of groups or organisations of objects so that decisions can be made by decision makers about how to use friendly organisations. SA goes beyond perception and encompasses the

combining, interpreting, storing and retention of information. At this level of SA, operationally relevant *meaning* and *significance* of the Level 2 data is being considered.

Level 4: The Predictable Level

The organisation sets quality goals that are measured as part of an organisational measurement program. Processes are well defined and measurements are consistent. Organisational control over performance is intended to narrow the variation in performance to within acceptable quantitative boundaries. Meaningful variations in process performance can be distinguished from random fluctuations. The performance of Level 4 organisations is predictable because performance is measured and operates within measurable limits. These measurements permit an organisation to predict trends in process quality and when the quantitative bounds of these limits are exceeded, action is taken to correct the situation. The key process areas at Level 4 focus on mentoring, team building, team-based practices, organisational competency management, and organisational performance alignment. At this level the data fusion is more about the situation and what is known from enemy doctrine and objectives to predict the strength and vulnerabilities for the threat and friendly forces. Almost at the highest level of SA, there is some capability to forecast future situation and events. A high level of understanding permits timely decision-making related to future events and their implications.

Level 5: The Transformational Level

At Level 5 the organisation is focused on continuous process improvement. The organisation identifies weaknesses and strengths proactively, with the goal of preventing the occurrence of negative performance. Innovations that exploit best practices are identified and transferred throughout the organisation. Level 5 organisations analyse defects to determine their causes. Level 5 organisations are continuously striving to improve the range of their process capability, thereby improving their performance. Improvement occurs both by incremental advancements in the existing process leveraging emerging innovations and transformational technologies. The key process areas at Level 5 address continuous improvement for personal competency development, coaching, and workforce innovation. The fusion process at this level examines what is unknown in the context of the situation and threat and then develops options for collecting the information. At the highest level of SA, relying more on tacit communications, organisations are self-synchronised and are heavily dependent on future predictions. SA becomes adaptive to different cognitive strategies in response to the dynamic aspects of real-world changes.

While no particular style of organisational structure dominates high maturity organisations; matrix, functional, product, and customer group structures are the most common. However, high maturity organisations are characterised by:

- Establishing a program of continuous workforce development with process improvement, leading a culture of excellence.
- Avoiding workforce practices that its employees are unprepared to implement effectively.
- Readily available and easily accessible process documentation.
- Limiting detailed standards, procedures, and checklists to tasks and not process
- Performing inspections emphasizing data collection.
- Using control charts and other statistically rigorous methods for monitoring process.
- Recognizing the importance of competent people.
- Requiring training in technical skills, management skills, and relevant application domains; including training in interpersonal skills, team building, and negotiating skills.

For Further Information:

The People Capability Maturity Model is further described on <http://www.sei.cmu.edu/products/prod.descriptions/p-cmm.html>

The "P-CMM" and the "Overview of the P-CMM" are described, respectively, at:

<http://www.sei.cmu.edu/products/publications/95.reports/95.mm.002.html>

<http://www.sei.cmu.edu/products/publications/95.reports/95.mm.001.html>

A.6. Appendix: Employment of IT Specialists In The Army Reserve

INTRODUCTION

1. This discussion paper summarises research into the structure and deployment of IS uniformed personnel in technology oriented forces. It concentrates on the US forces as exemplars of the most successful technology focused force and discusses the use of Reserve forces to augment and supply specialist services to the ADF.
2. These results from the research proposes:
 - The raising of Reserve IS cells at formation level,
 - The raising of regional Reserve IS cells for infrastructure support and systems integration tasks,
 - The raising of a national Reserve IS cell for support on national projects.
3. The rest of this paper seeks to provide sufficient background information of the key research results. It will first examine the US Army Information Operations Career Field and then consider implications for the reserve in meeting these challenges. This is followed by a brief consideration of the issues of outsourcing these functions to civilians. The issue of organisational position (rank) is addressed after demonstrating that uniformed personnel are required. This paper closes with summarising the findings and making recommendations to raise formation, regional and national IS units in the Defence Reserves.

US ARMY INFORMATION OPERATIONS CAREER FIELD

4. Various fields supporting ICT in the US Army have been determined. These specialisations may be entered into from the 5th year of commissioning. They specifically identify the Information Operations Career Field (IOCF).
5. These specialisations are formed in response to the requirements of the 21st century Information Age and are consistent with the US Army Vision 2010, which identifies "*Gaining Information Dominance*" as fundamental to all future Army patterns of operation, as we also identify.
6. This specialisation (IOCF) brings together related disciplines with associated functional areas and incorporates several new ones. The functional areas in this career field are defined in Reference A as:
 - FA 24 (Information Systems Engineering),
 - FA 30 (Information Operations),
 - FA 34 (Strategic Intelligence),

- FA 40 (Space Operations),
 - FA 46 (Public Affairs),
 - FA 53 (Information Systems Management), and
 - FA 57 (Simulations Operations).
7. There is a requirement for all but FA 40 within the ADF. Army does provide for specialist positions in Information Operations within Signals and for Public Affairs. There seems to be little current employment opportunities in the other areas.
 8. There is, through the current restructuring of CSI-G, an intent of maximising the talents of civilians and military to provide an integrated warfighting capability using appropriate technology. There is a need for military personnel to be involved in this process in order to provide the cultural linkages between the civilian and military systems. This aspect is specifically referred to in Reference B, when defining the role of Information Systems Specialists within the US Army:

FA 53 is a vital part of the Army's ability to leverage technological opportunities and achieve information dominance in the 21st Century. This functional area concentrates on the management of computer information systems and networks. On the battlefield and in routine domestic operations, commanders are inundated with real-time information from a multitude of sources. As future generations of information systems are fielded, the Army's ability to collect information will further accelerate, thereby increasing the requirement to rapidly process the data and formulate decisions. To meet this need, FA 53 officers are developed through a comprehensive approach to personnel management which includes progressive training, education and repetitive assignments in this highly technical area. They provide experience in the planning process, operations and information systems arenas and are the link which ties together the Army's warrior and cyber skills.
 9. Similarly, in the field of Simulation Support, the US Army has created the specialist functional area, FA57. The specific needs for this functional area are described at Reference C. Here, too, the role is not one of code cutting, but providing the military interface between the civilian specialist developers and the tactical trainers. This was repeated by the FA57 Proponent Officer in Reference D, when he said
 10.

What is in greatest demand is the military operations expert who knows how to train forces and can articulate the requirements in simulation based training strategies and designs. Additionally, there is a bridge required between the military operationalist and the programmer. Very few computer engineers, designers, programmers have military experiences or understand the complexity of our C4 interfaces and the difficulty/necessity to provide sustainment training.

IMPLICATIONS FOR THE RESERVE

11. The use of Defence Reservists is a cost effective means of providing this integration in key elements in the Information Operations Career Field. Note that the US Army uses its reservists in each of these roles.

THE ISSUE OF OUTSOURCING

12. There is an argument for civilianising all IT development and IT support. Discussions with the world's leading researchers on outsourcing effectiveness (Professor Rudy Hirschheim, Professor Leslie Willcocks, Professor Michael Vitali and Mr. David Feeny) leads to the conclusion that outsourcing all ICT support is inappropriate. What is required is to maintain the cultural links in the use of the technology as shown in Reference E. This appreciation can only be gained through uniformed service. Credibility with users of systems requires an understanding and appreciation of the practiced culture of the organisation. This means that uniformed ICT consultants will have a greater effect on the adoption and effective use of ICT than non-uniformed consultants.
13. In addition, we should not be seeking to just train our users and managers in extracting data from the administrative systems, but empower these users to make effective decisions using the range of information systems at their disposal. The study at Reference E shows that despite the best intentions of organisational leaders through effective management support and opportunities for participatory decision-making, empowerment did not occur because the practices collided with the operant organisational culture. 'Boundary spanners' are people who can relate the new organisational systems to the actual organisation and effect organisational and cultural change. These people are generally members of the organisation who occupy respected positions. Thus, uniformed personnel are required in order to effect organisational change based on Information Technology in a uniformed environment. This is the rationale used in raising the FA53 and FA57 areas within the US Army.

ORGANISATIONAL POSITION TO BE AN EFFECTIVE CHANGE AGENT

14. Finally, there is an argument that relates to the organisational position of such change agents. To be effective, these change agents must be at the same level in the organisational hierarchy as the functional managers. Ein-Dor and Segev showed that IT managers placed more than two levels below the CEO had negligible effect on the strategic use of IT. This result has been supported in management studies. Thus, in a Brigade where the management team is staffed by Majors, a Major (IS) is required. At higher formations where the management team is staffed by Lieutenant Colonels, a LTCOL (IS) is required.

CONCLUSION

15. This brief paper has argued that there is a need to provide ICT expertise in uniform in order to achieve business outcomes from our significant investment in applications supporting administration, logistics and warfighting. Uniformed personnel are required in order to bridge the cultural gap between the military

users and civilian developers. This requirement has been recognised by the US Army in its formation of the Information Operations Career Field.

16. The paper also argued that the most cost effective way of providing that connectivity is through the use of Defence Reservists. Indeed, Defence has and will continue to find it difficult to retain ICT skills in an increasingly technology dependent world. The use of Reservists will ensure that Defence can leverage off the expertise of personnel through their civilian employment and give these personnel specific military experiences that ensure credibility with uniformed personnel.
17. Finally, the paper has shown that rank is an important parameter when seeking to empower or transform organisations through Information Technology. Numerous research studies have shown that IT management rank must be the equal to that of the senior management team in order for the organisation to effectively use its technology. Thus, the minimum rank for effective IT management at Brigade level is Major, and that required at higher formations is Lieutenant Colonel.
18. A case has been presented to raise IT units at formation, regional and national levels. The next section summarises the recommendations made for each unit.

RECOMMENDATIONS

19. It is recommended to:

- Raise Reserve IS units at formation level,
- Raise regional Reserve IS units for infrastructure support and systems integration tasks,
- Raise a national IS unit for support on national projects.

20. The configuration of each of these units follows.

- IS units at formation level should be managed by an officer at the same rank as the other senior managers: Major on Brigade and LtCol at higher formations. The role of these officers is to assist in the strategic planning for IT and the alignment of IT with the operational and administrative tasks of the unit. These officers should have a small support staff capable of providing first line infrastructure support and limited systems integration duties. The size of this cell should be limited to one or two officers (LT or CAPT) depending on the scope of programs under implementation and two infrastructure support personnel (CPL).
- Second line support to formations and further systems integration projects should be provided by regional IS cells. These regional units should be commanded by a Major (supported by a SGT ADMIN) and be constituted by infrastructure support teams and systems integration teams as follows.
- Each infrastructure support team should be commanded by a CAPT supported by a SGT (Operator Computer). Each team should have appropriate resources to undertake infrastructure support for an 8 hour shift.

Thus, 24 hours operations will require the raising of three sections, each led by a LT, with 2 CPL Operator Computer. This redundancy in staffing allows for staff to be on course or on leave.

- The systems integration team should have sufficient resources to undertake projects completed over a 4 month period. Each team should be commanded by a CAPT Programmer Analyst, and have at least 2 LT Programmers. The number of such teams depends on the size of the region. It is recommended that there be a minimum of 2 such teams per region and preferably 3. This latter configuration would give a capacity of 3 concurrent projects per region.
- The national IS unit should consist of experienced IS staff, generally of the rank of LTCOL and MAJ. The size of this unit has yet to be determined, but these should be organised on a team basis constituted as required. Each team should be lead by a LTCOL and have up to 2 Majors. These teams should focus on strategic issues and change management issues in order to ensure that implemented information systems lead to effective business outcomes. There should be one team per major system. Infrastructure teams should come under command infrastructure support and systems integration and application support teams should come under command applications development. Other teams can be raised or directed to develop specific projects as the needs arise.

21. This range of Reserve ICT assets harnesses civilian expertise and effectively integrates this expertise within the Defence uniformed culture. This use of reservists is a low cost, low risk option. In addition, this approach will encourage empowerment of users through alignment and careful attention to cultural change. In addition, suitable selection, training and development of Reservists should foster transformation of the organisation to become an effective technology driven organisation. This will occur only through supporting management use of ICT, encouraging successful use of information systems and fostering continuous business improvement. These latter aspects are the hallmarks of innovative and successful organisations. They should become the hallmarks of the Australian Defence Force.

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19. ABSTRACT Much of the NCW related work done by the military has been in technological and operational domains. The literature review in this report focuses on the human and organisational factors that need to be considered to make the most of the future NCW context and enable future warfighters to deal with war, peace, terrorism and overall uncertainty. Particular focus is placed on the transformation of warfighting and the issues that individuals and groups face in the NC environment. Such issues include: organisational culture, cognitive demands, the nature of information, C2 processes, knowledge mobilisation and learning, and transformational pathways organisations may follow while changing from a traditional hierarchical way of operating to more flexible and decentralised structures. The report concludes with suggestions for future research in the human dimension of effective NCW.					

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